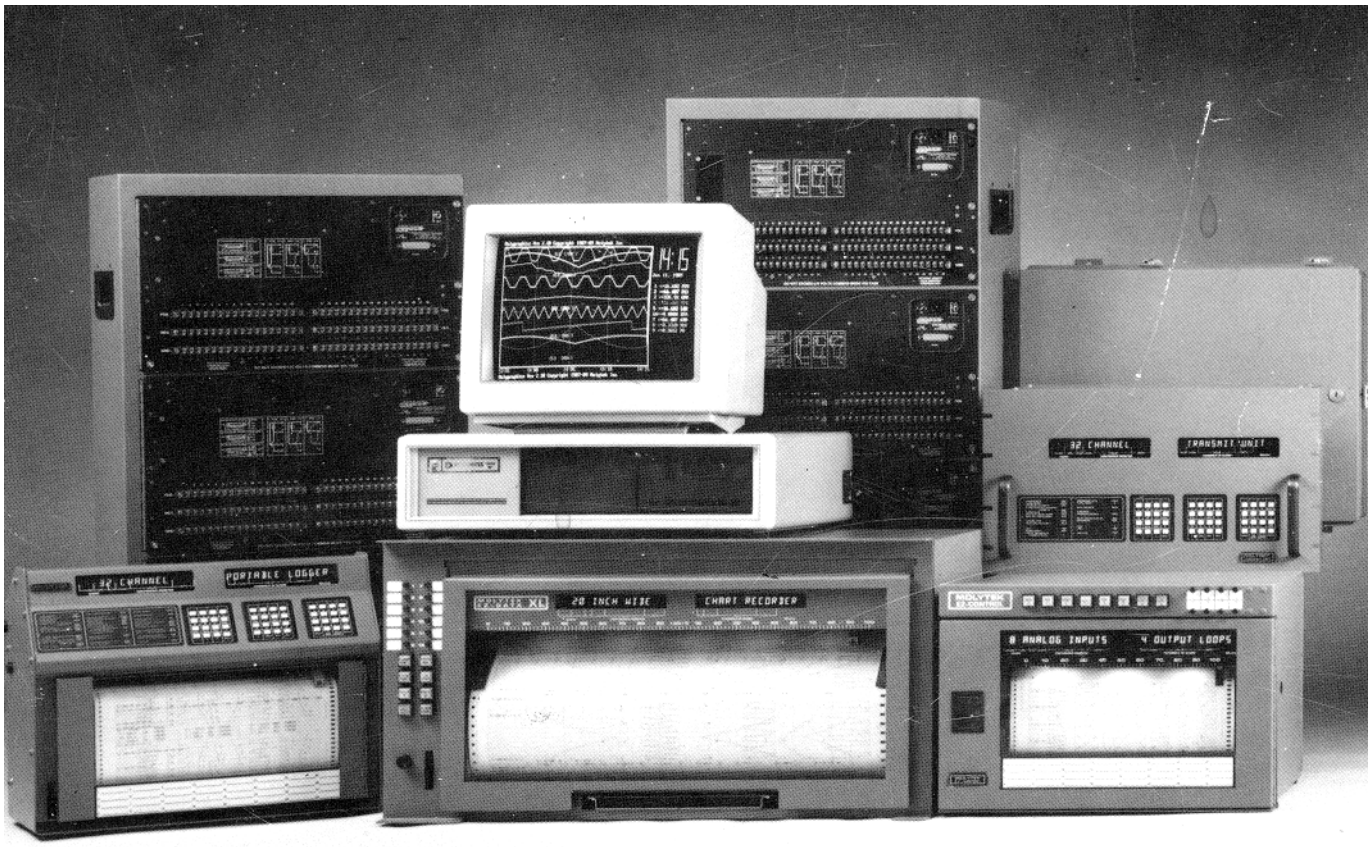
Maintenance and Troubleshooting Manual

Recorder/Datalogger and RTU Instruments



Molytek
DATA ACQUISITION SYSTEMS PRODUCTS

REV 101703

Recorder/Datalogger and RTU Instruments

Maintenance and Troubleshooting Manual

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1. INTRODUCTION

1.1 How To Use This Manual

This manual is a service guide for multipoint recorder/dataloggers, RTU data acquisition instruments and programmer/recorder/controllers. This manual is intended to be used with the Recorders/Dataloggers and RTU Instruments Operating Instructions manual as the second volume of a two-volume set.

These instruments utilize the same digital components contained on the same printed circuit board assemblies: the digital processing circuit board, the input board, the display board, the relay board (if equipped) and the current source board (if equipped). These circuit boards are mounted in different orientations in different units, but functionally they are identical in all instruments. The mechanical print head drive and chart drive assemblies used in both the sliding chassis and portable chart printing instruments are also virtually identical.

The following section, Parts Inside, will show you how to open the cases of the various instruments and will help you to become familiar with the parts inside of your instrument. The procedures outlined in Section 3, General Maintenance, refer to all of the instruments. Section 4, Printing Maintenance, and Section 5, Chart Drive Maintenance, will be important if you are servicing the sliding chassis or portable models with chart printing capability. If your instruments do not have a self-contained chart then disregard these sections. Removal and replacement procedures for the circuit boards in Section 6, Circuit Board Removal and Replacement, apply to all of the instruments. The information contained in the remaining sections: Troubleshooting Guidelines, Problems and Possible Causes, Parts Lists and Schematics; also applies to all instruments.

Always check the programming set-up of your instrument before beginning or carrying out any hardware repairs, see Program Checks, Section 17 in the Operating Instructions manual.

Although our warranty is subject to terms and conditions, please do not allow the wording to stop you from attempting to correct your problem in the field. Any reasonable attempts at repair will not void the warranty.

1.2 Warranty Statement

This instrument is warranted for a period of two years against defects of material and workmanship subject to the terms and conditions set forth below.

1. The warranty is in effect at date of shipment from the factory to the original purchaser.

2. Expendables such as print heads, chart paper, fuses, lamps etc. are not covered by warranty.

3. Claims against this warranty for replacement parts and/or services shall be limited to defects in materials and workmanship. Malfunctions attributable to neglect, abuse, or repair and operational procedures not specifically recommended by the factory are not warranted.

4. Service repairs and/or piece part replacement shall be warranted for a period of ninety (90) days commencing on the date of return shipment or until the expiration of the remaining term of the original instrument warranty, whichever is later.

5. The manufacturer shall not be liable for consequential damages nor for labor, loss, or expenses directly or indirectly related to the use of the manufacturer's products or equipment.

6. This warranty does not apply to shipping damage. Claims for damages incurred while products are in transit rest with the purchaser. Said claims are to be levied against the carrier.

7. Amendments assumed corollaries or statements contrary to the terms of this warranty shall not be binding upon the manufacturer unless they are expressed in writing and approved by an officer of the manufacturer.

8. The use of any replacement parts and/or supplies other than factory approved replacement parts and/or supplies throughout the warranty period shall void the warranty and release the manufacturer from any responsibility or warrantability of the unit.

9. **THE MANUFACTURER MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR ANY PARTICULAR PURPOSE.**

10. Warranty service is F.O.B. point of manufacture. All transportation charges to and from the manufacturer's plant shall be the responsibility of the purchaser.

1.3 Return Shipment Procedure

An instrument or product may be returned to the manufacturer's plant after first contacting the factory for a "RETURNED GOODS AUTHORIZATION" number. The serial number of the instrument involved and a brief description of the reason for return is required in order to issue this number. The authorized return number should be referenced on all correspondence regarding the return. Additionally, this number must appear on packing slips and containers used to return said products. Warranty repairs are F.O.B. the factory. Shipping costs to and from the factory are the customer's responsibility. All units returned for warranty repair must include a sample of chart paper or a copy (if it is a printing unit), or a written description of the complaint condition.

2. PARTS INSIDE

2.1 Sliding Chassis Instruments

2.1.1 Sliding out the chassis

1. Program the recorder for standby operation Sliding Out The Chassis mode in the OPER menu sequence.

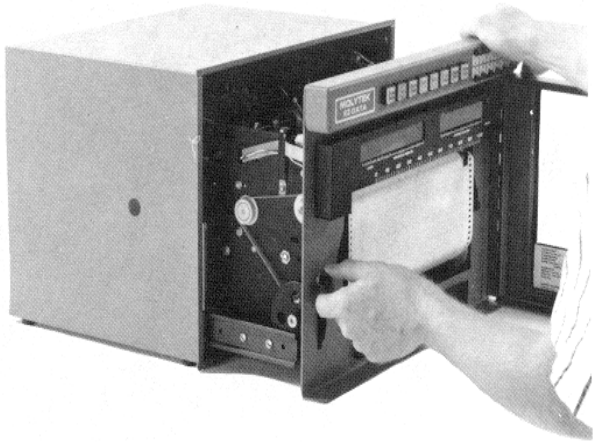
2. Unplug the power cord from the outlet (recommended).

3. Open the front door. Rotate the chassis release knob clockwise 1/4 turn.

4. Grip the front bezel of the recorder and pull the chassis out until the chassis slide release buttons lock into place. The chassis slide release buttons are spring-loaded tabs or "buttons" which lock into chassis slides.

5. To slide the chassis back into the outer case, locate the chassis release buttons on the chassis slide, push in to disengage and unlock the chassis slides. Firmly and evenly push the chassis back into place and lock the chassis release knob on the front panel.

Sliding Out The Chassis

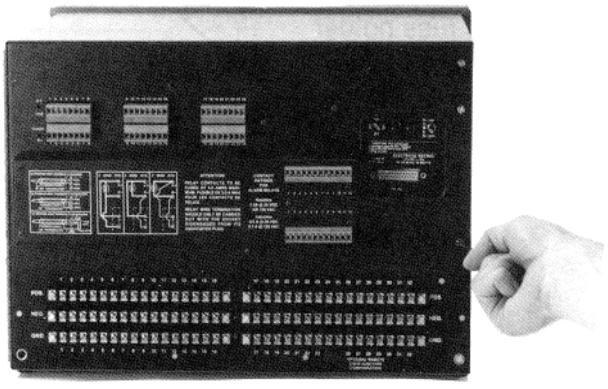


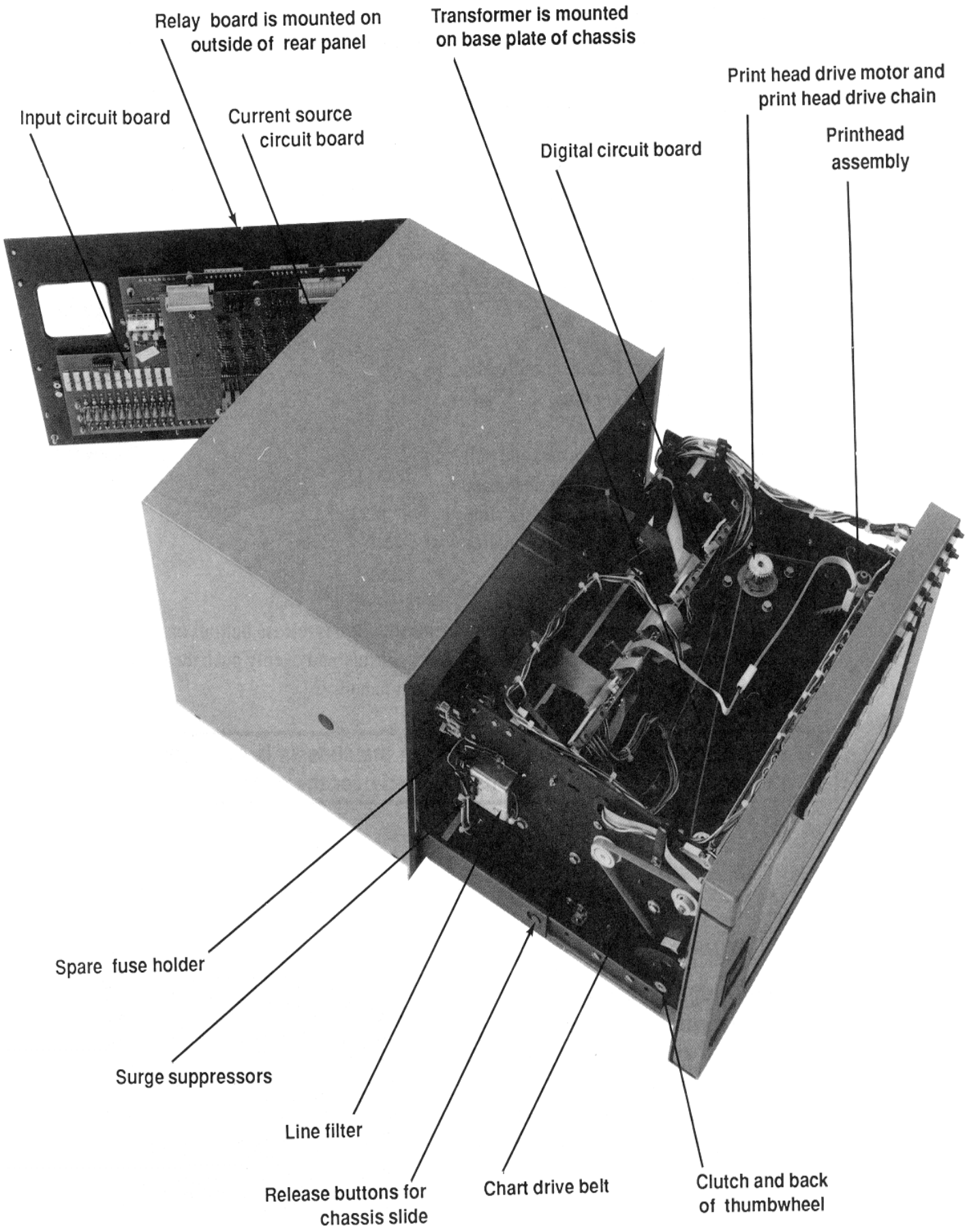
The recorder will become front-heavy when the chassis is extended. Do not allow extended chassis to hang unsupported over the edge of a bench.

2.1.2 Opening the rear panel

Access may be gained to the input and digital circuit boards by loosening the screws along the right side of the rear panel as shown in the illustration. The rear panel is hinged at the left side and will open to expose the digital circuit board, the input circuit board and the current source board if equipped.

Opening The Rear Panel




Relay board is mounted on outside of rear panel
Transformer is mounted on base plate of chassis
Print head drive motor and print head drive chain
Input circuit board
Current source circuit board
Digital circuit board
Printhead assembly
Spare fuse holder
Surge suppressors
Line filter
Release buttons for chassis slide
Chart drive belt
Clutch and back of thumbwheel

2.2 Rack Mount and Free-Standing RTU Instruments

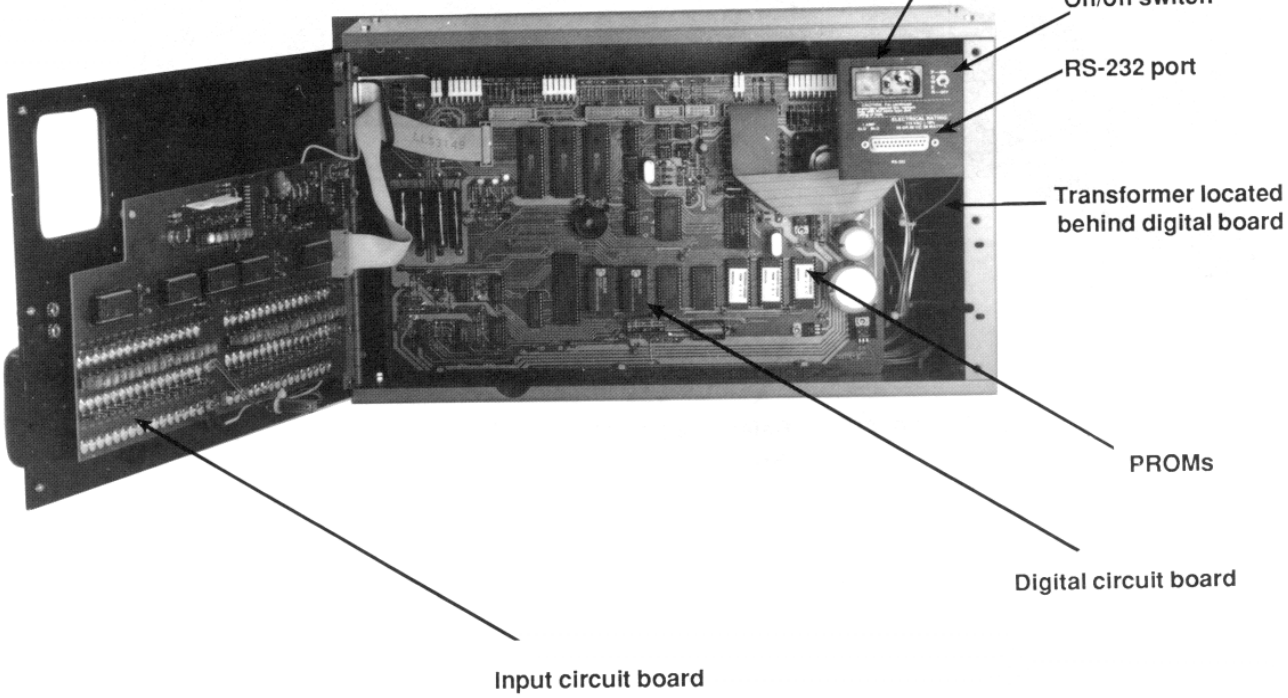
1. Before opening the outer case, turn the power switch off and unplug the power cord from the outlet.

2. Loosen three (3) captive screws along the right side edge as shown in the illustration. Panel is hinged and will open to give access to circuit boards.

3. The orientation of the parts in the inside of the free-standing cabinet is slightly different than shown below in the photo of the rack mount RTU.

Rack Mount RTU

Parts Inside Rack Mount RTU



2.3 Portable Instruments

2.3.1 Removing the rear panel

1. Program the recorder for standby operation mode in the OPER menu sequence.

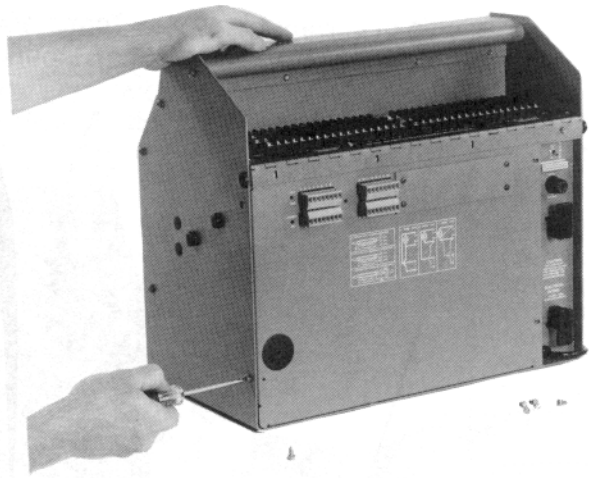
2. Turn the power switch off and unplug the power cord from the outlet.

3. Remove two screws along the rear panel and two screws along the side panel as shown in the illustration.

4. Loosen three screws along the top hinge as shown in the illustration. Also, the fourth screw, above the on/off switch, needs to be loosened slightly.

5. Remove the rear panel for access to the digital circuit board.

Removing The Rear Panel



2.3.2 Opening the top panel

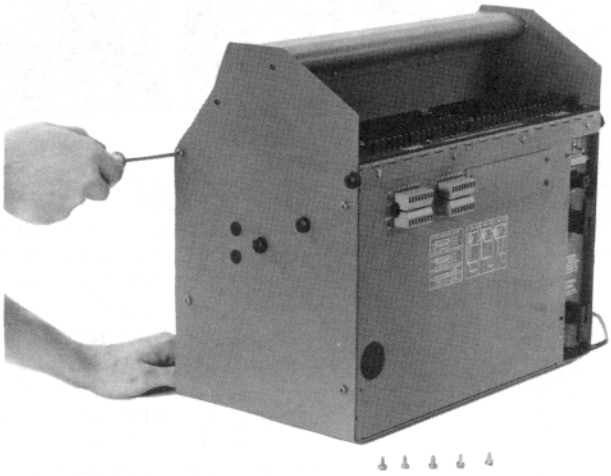
1. Program the recorder for standby operation mode in the **OPER** menu sequence.

2. Turn the power switch off and unplug the power cord from the outlet.

3. Remove six screws, three from each side as shown in the illustration.

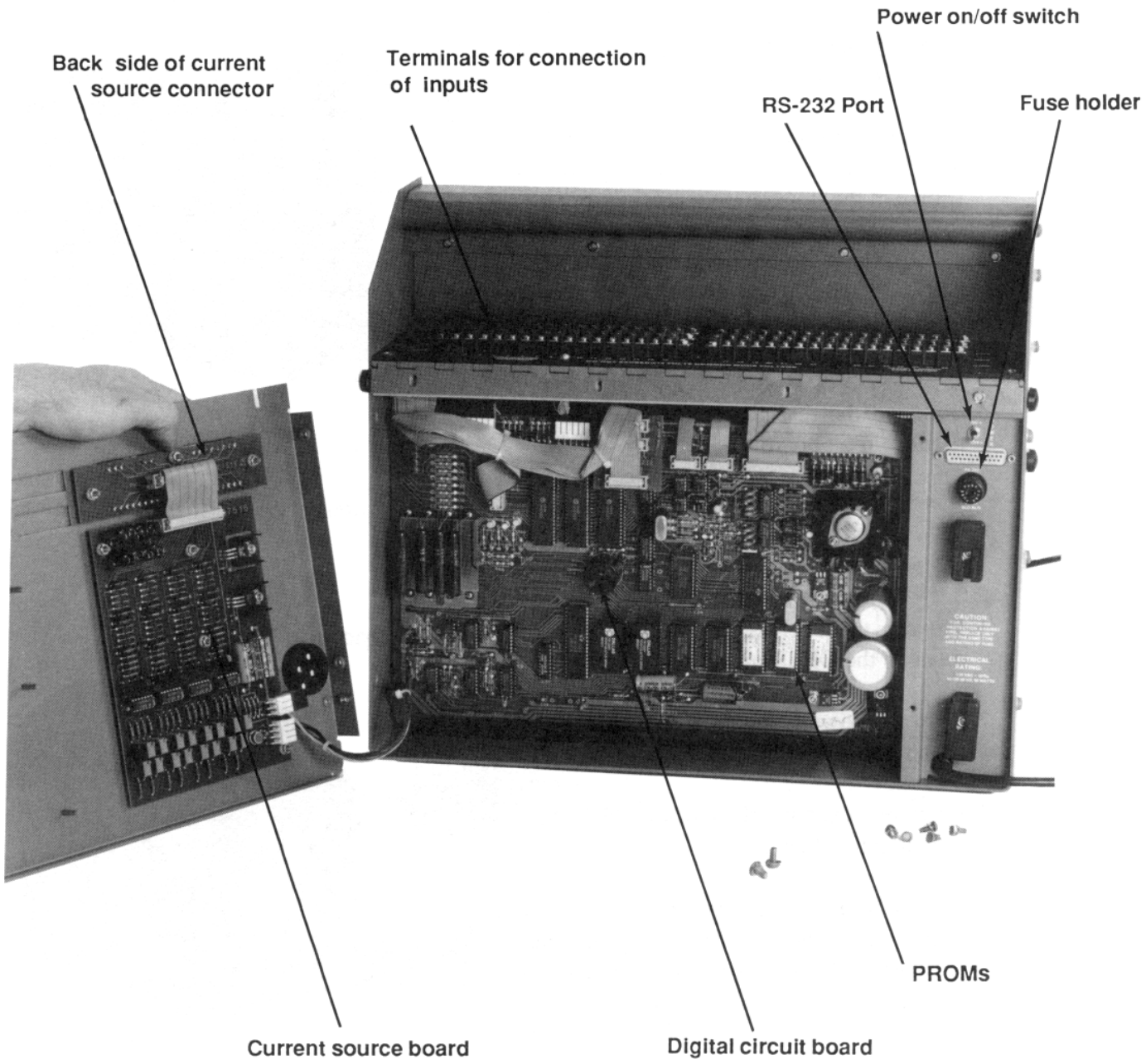
4. Lift the top panel for access to the input circuit board, the back of the keypads, the display board plug and the top portion of the main chassis assembly.

Opening The Top Panel

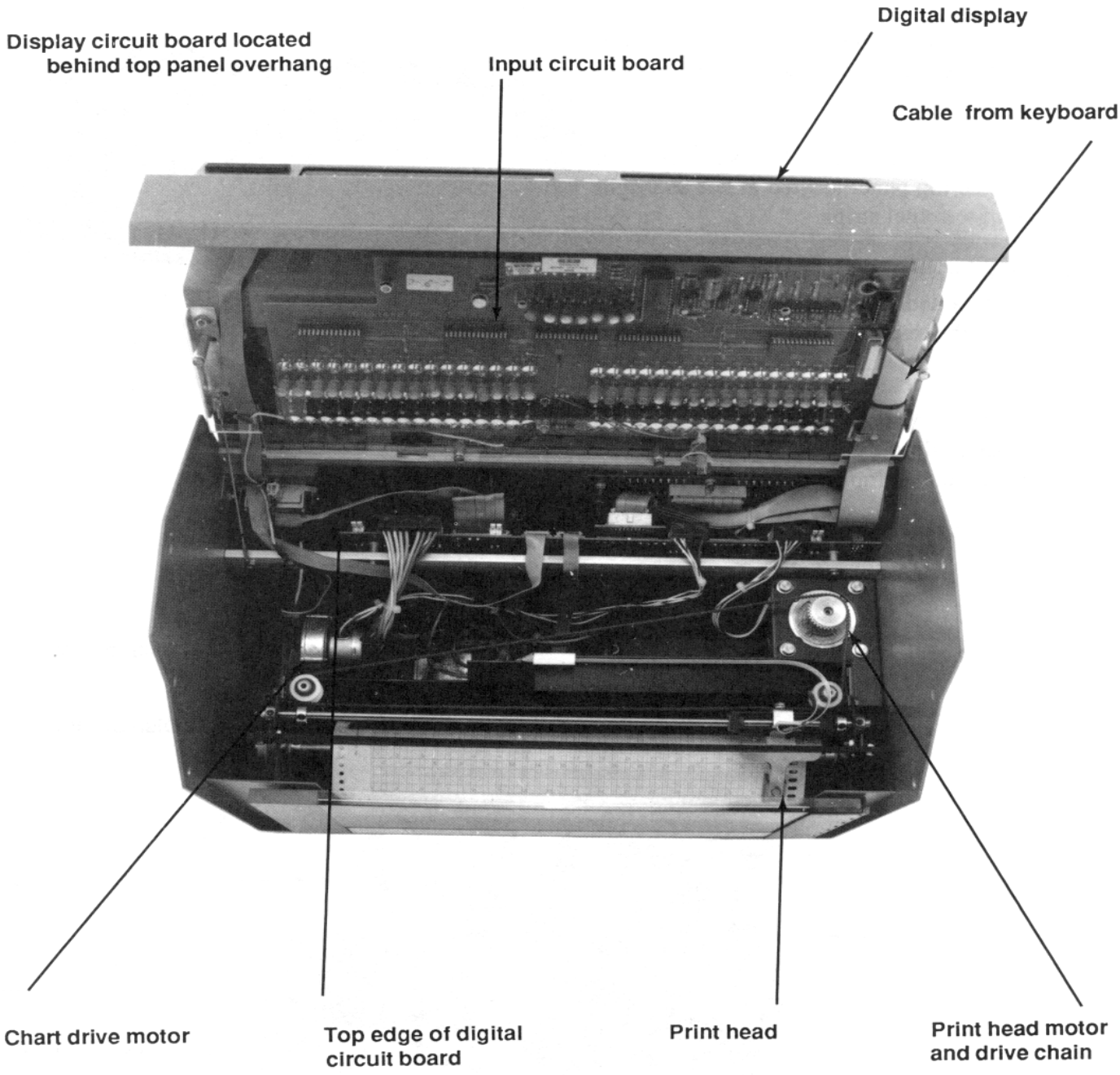


Important !
The screws along the hinge panel must be in place in order for the hinge to hold the top panel when the top panel is opened.

Portable Instrument With Rear Panel Removed



Portable Recorder With Top Panel Opened


Digital display
Display circuit board located behind top panel overhang
Input circuit board
Cable from keyboard
Chart drive motor
Top edge of digital circuit board
Print head
Print head motor and drive chain

2.4 Table-Top Instruments

1. Turn the power switch off and unplug the power cord from the outlet.

2. Remove four (4) phillips head screws from each side panel of outer case (8 phillips head screws total).

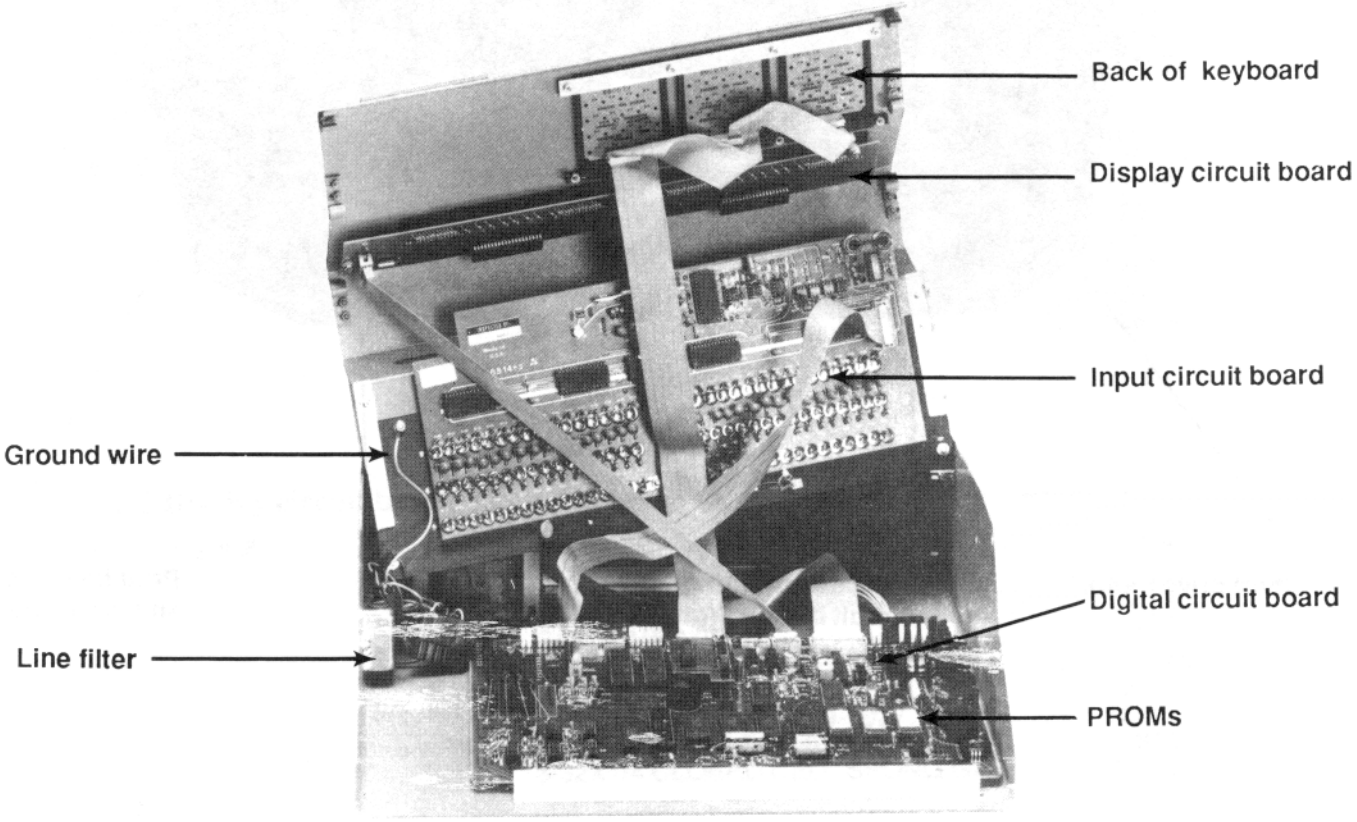
3. Loosen two (2) captive screws on the black I anodized top panel located at left and right side of terminal strips.

4. Lift up the top panel. Three circuit boards are contained inside the case: the digital board, the input board and the display board.

Table Top Model

5. Unplug the ribbon connectors and remove the nut holding the ground strap to release the top panel completely.

Table Top Logger With Outer Case Opened



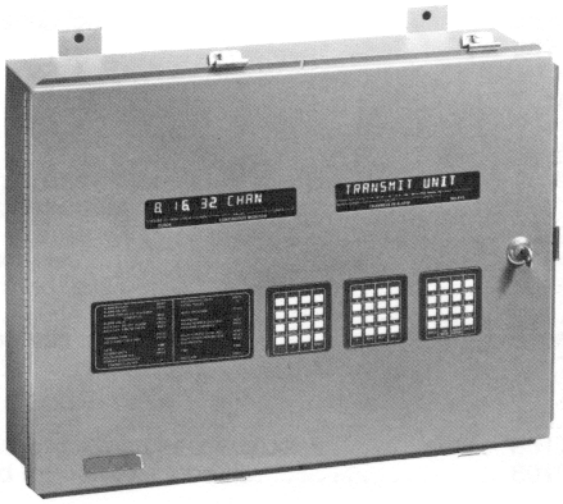
2.5 NEMA Type RTU Instruments

1. The NEMA type outer case is secured by five stainless steel slotted clamps and a key lock.

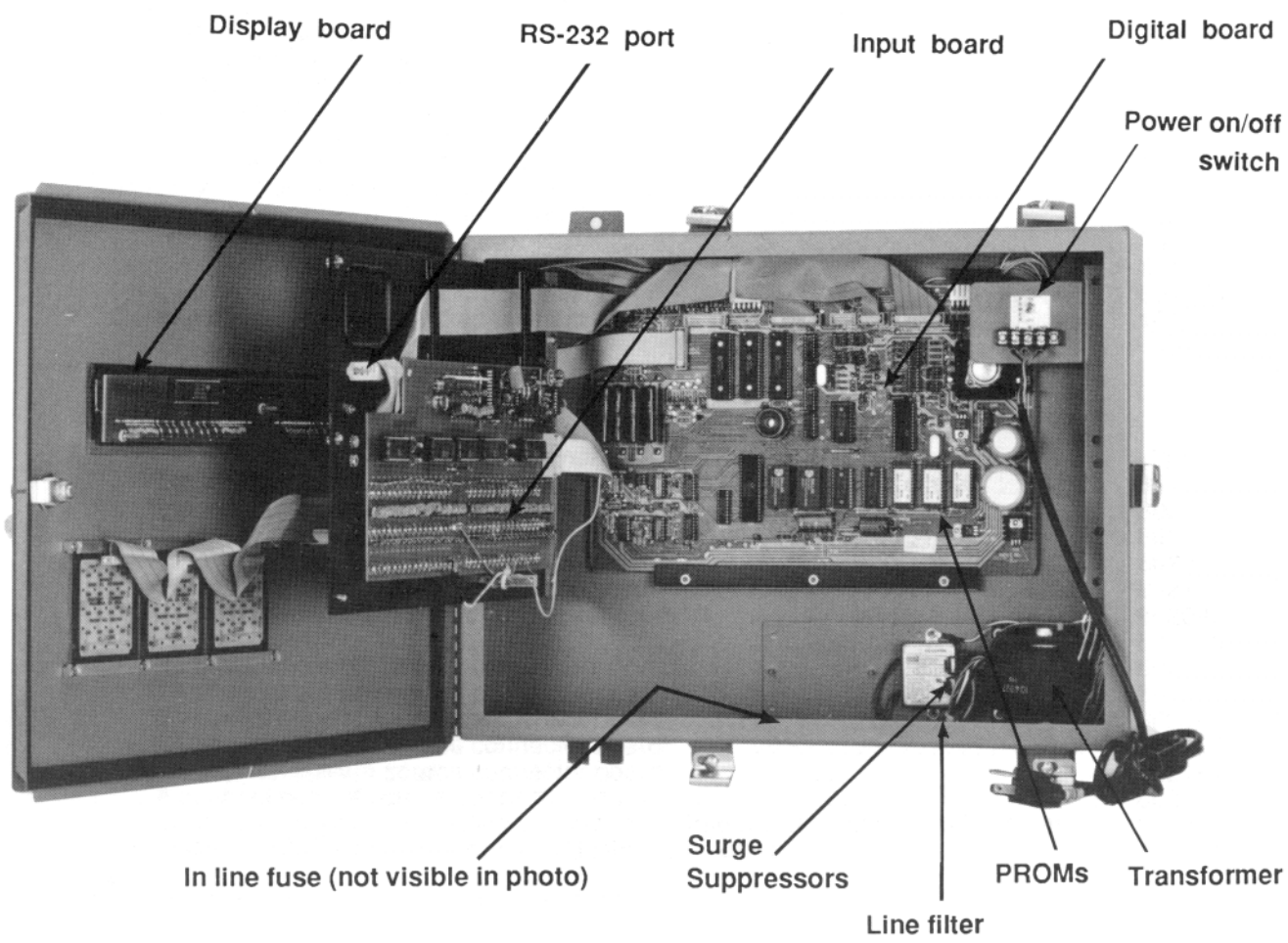
2. Unscrew the screw-clamps enough to allow them to slide back and forth within their slots. When loose, the clamps can be flipped up to release the front door.

3. Use the key provided to open the tumbler lock and the front door will open on its hinge.

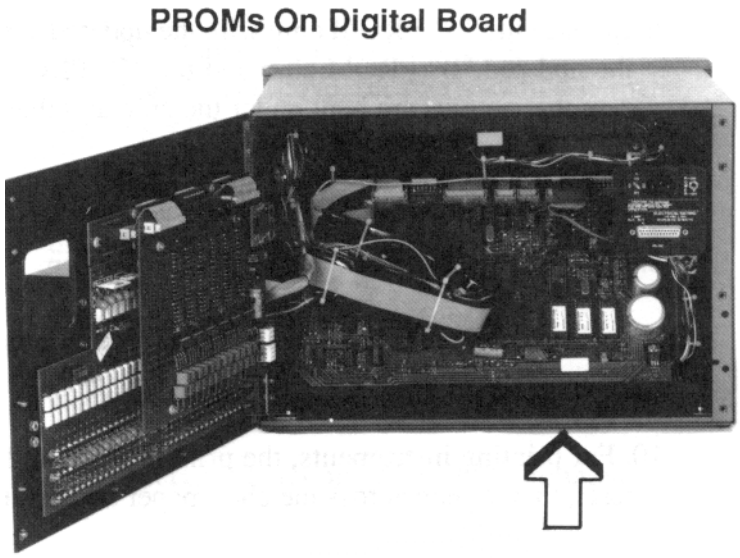
NEMA Type RTU



NEMA Type RTU With Front Door Opened



3. GENERAL MAINTENANCE



The replacement procedure outlined below requires clearing the instrument memory. We recommend obtaining a **print out of the instrument parameters using the selections contained in the DISP key menu sequence before carrying out the PROM replacement procedure. This will allow easy re-programming and the quick return of your instrument to service.**

3.2 PROM Replacement Procedure

1. Program the instrument to the STANDBY operation mode, which is accessed in the OPER key menu sequence.

2. Turn power switch OFF and unplug the power cord from the outlet.

3. Open the case of your instrument and locate the digital circuit board.

4. Locate three PROM chips at the bottom right corner of the digital board. These chips are labeled PROM "A" (E-11), PROM "B" (E-12) and PROM "C" (E-13). The software version of the PROMs will be written on the PROM labels.

5. Remove and replace one PROM at a time using a PROM puller or small screwdriver to gently pry up the chips from their sockets.

Each chip has a notched or otherwise marked end, which corresponds to a notch in the socket. Make sure that you install the replacement chip so that the notch or mark of the chip is matched up with the notch in the chip socket.

6. Replace the “A” PROM chip with the updated version “A” PROM chip, the “B” PROM chip with the updated “B” PROM chip and the “C” PROM chip with the updated “C” PROM chip. Take care that no pins are bent under the chip and that the chip is firmly seated in the socket.

7. Close the outer case of your instrument.

8. Plug in the power cord and turn the power on.

9. On instruments equipped with digital displays, the displays should light and identify the software version when power is applied.

10. For printing instruments, the print head should make one non-printing pass from left to right, reset, then sweep across the chart paper and print the software version.

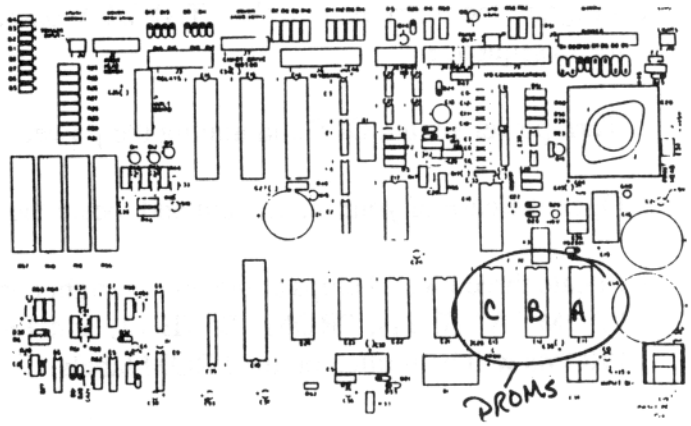
11. If the instrument beeper continuously sounds when the power is restored, turn the power off, open the outer case and check that the chips are fully seated and that no pins have been bent underneath the chips.

12. Clear the memory on instruments with keyboard and digital displays by pressing the X key. The left display will show STOP ON LEFT. Press the ENTER key. The left display will show ADJ RIGHT MARGIN. Type 77, which should appear on the right section of the display, and press the ENTER key.
13. Clear the memory on instruments that are not equipped with display and keyboards by removing and swapping RAM chips E-23 and E-24 on the digital circuit board.

14. Re-Program the instrument and return it to service.

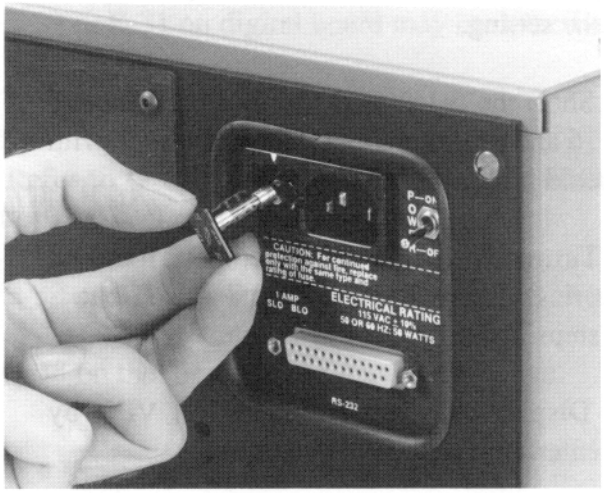
15. Package the old PROMs and include with them a copy of the invoice sent with the updated PROMs so that proper credit can be issued upon their return.

Location On Component Map



3.3 Fuse Replacement

Location Of Fuse Receptacle



The fuse is located in a receptacle in the ON/OFF switch and line cord socket section of the rear panel on sliding chassis, table-top, rack mount and free standing instruments. The fuse receptacle on these models is behind the square voltage selector plate and can be removed by inserting a small screwdriver into the notch in the receptacle to pop out the square voltage selector plate. The sliding chassis models have a spare fuse provided in a plastic holder inside and behind the Power On/Off and voltage selector unit. It is accessible by fully extending the recorder chassis.

On portable instruments the fuse is located in a bayonet-type cartridge fuse holder below the on/off switch on the rear panel. See the Parts Inside section for fuse location.

On NEMA models the fuse is located in an in-line fuse holder inside the cabinet. See the Parts Inside section for fuse location.

Use only a 1 Amp 250 Volt Slo-Blo fuse as a replacement. When replacing the fuse receptacle, on the sliding-chassis, tabletop, rack mount and freestanding models, ensure that the proper line voltage setting is aligned to the white arrow.

3.4 Cold Junction Compensation

3.4.1 Adjustment

To adjust the cold junction compensation in recorder/RTU instruments equipped with the standard input board, use a precision ice bath (or other accurate, controllable temperature source) and an accurate thermocouple. Install the reference T/C on channel 16. Before making the adjustment, install the input connection terminal strip and turn the instrument power on for at least 30 minutes, or preferably for several hours.

1. Display or print the cold junction temperature of a reference channel (channel 16 if possible) in order to make an adjustment to the setting.

2. Short the (+) and (-) terminals on channel 16 and program as a temperature type with cold junction on (PROG key).

3. Turn channel 16 on, by selecting, “on” for trend printing, datalog printing or ASCII out in the PROG key menu.

4. Display channel 16 on the left VFD by entering it in the H key sequence.

5. To print the reference channel reading, select datalog type of chart recording and enter a datalog interval in the CHART key. Select OPERATE/AUTO in the OPER key to engage the chart drive motor.

6. The adjustment potentiometer is located below the input connection terminal strip on all instruments equipped with a standard input board. After allowing time for thermal equilibrium, adjust the pot to make the recorder/RTU reading agree with the ice bath or other known temperature source.

7. The cold junction setting can be checked at any time by selecting the "TIME, CJ, PAP LEFT" selection in the DISP key menu.

Instruments equipped with the optional high common mode input board do not have an adjustment potentiometer. Cold junction compensation on the high common mode boards is performed automatically. However, version 5i high common mode input board has a software adjustment. This is programmed via the last step in the MISC key sequence. The prompt is: “CJC ADJUST=”. By default the cold junction offset is zero degrees Celsius (32 degrees F). The CJC sensor should be centered within ice (0 Celsius or 32 degrees F). Thus, when the instrument is in the degrees F mode, you should program the “CJC ADJUST=” to 32 degrees F.

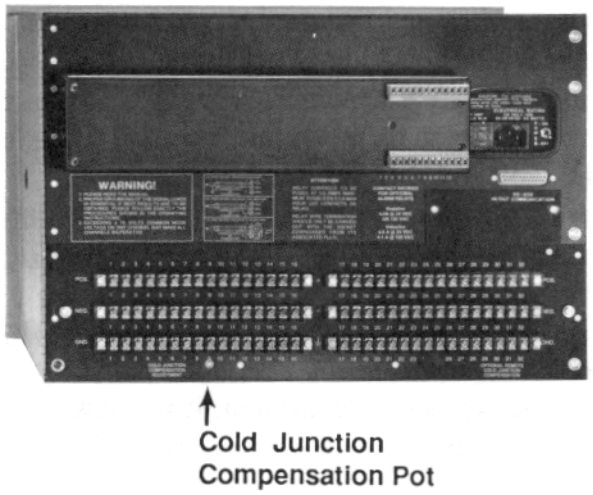
Examples:

Instrument reads high 0.1 degrees C .
Program the “CJC ADJUST=” to –0.1 C

Instrument reads low 1.3 degrees C .
Program the “CJC ADJUST=” to +1.3 C

Instrument reads high 1.1 degrees F .
Program the “CJC ADJUST=” to +30.9 F

Instrument reads low 0.9 degrees F .
Program the “CJC ADJUST=” to +32.9 F



This setting is displayed via the DISP key, under the “TIME, CJC, and Paper Left” selection.

3.4.2 Disable

In certain applications it may be desirable to have linear thermocouple signals but without cold junction compensation. This can be accomplished through the recorder software by selecting NO for step 5, “COLD JUNC COMP?” of the PROG key sequence.

3.4.3 Remote temperature sensor

It is possible to remove the cold junction temperature sensor from the recorder and locate it up to several hundred feet away from the instrument. This option can be done at the factory if specified at time of ordering or it can be done in the field. Refer to drawings 801711 and 801773 at the back of this manual for details.

3.5 Calibration Verification

With the exception of the cold junction compensation adjustment on instruments with the standard input board, these instruments are totally self-calibrating. All amplifiers are digitally calibrated every 2 seconds through the scanning of a reference circuit after each scan of the active channels.

To verify that the recorder is reading properly, connect a 0 to 10 volt precision voltage source to the input of any channel and program that channel as a voltage type. Turn datalog printing on and program the channel for display on the digital display (H key). If you are transmitting to a terminal or computer, turn the ASCII OUT IS step on.

The instrument reads voltage in the following 5 ranges with the tolerances listed. Adjust the output of the voltage source to verify that the instrument is reading on all ranges.

Range	Possible Error In Measurement
1mV	5uV
10mV	10uV
100mV	l00uV
1V	1mV
10V	10mV

If the voltage displayed on the chart is the same as the source output then the temperature is also correct since the linearization is in the software and is calculated digitally. The cold junction compensation pot must also be properly adjusted for correct temperature readings.
If you experience questionable readings on some channels, always check the entries for slope intercept and 40 point look up tables if extra tables have been entered to linearize the output of the transducer. The entries for tables can be easily checked in the DISP key menu, TABLES selection. See the section Program Checks in the Recorders/Dataloggers and RTU Instruments operating instructions manual for complete information on checking the extra table programming.

3.6 Removing The Chassis On Sliding Chassis Instruments

1. Extend the chassis as described previously.

2. Familiarize yourself with the multi-pin connector cables along the top of the digital circuit board. See Circuit Board Removal and Replacement section.

3. Locate cable connector J-5, 1/0 communications at the left of the digital board. Unplug and remove J-5.

4. Unplug J-l (from input board) andJ-3 (from relay board if equipped.)

5. Remove the chassis ground wire connection at upper right side of chassis.

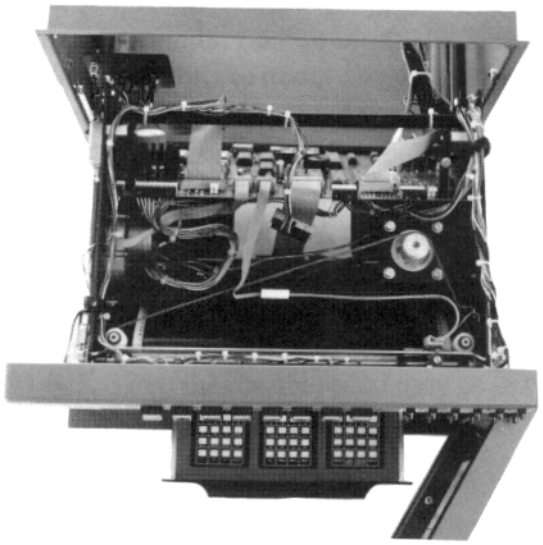
6. Push in the chassis release buttons on each chassis slide and pull chassis completely free from the outer case.

7. To re-install the chassis line up the chassis slides and push chassis in until chassis release knobs lock into place.

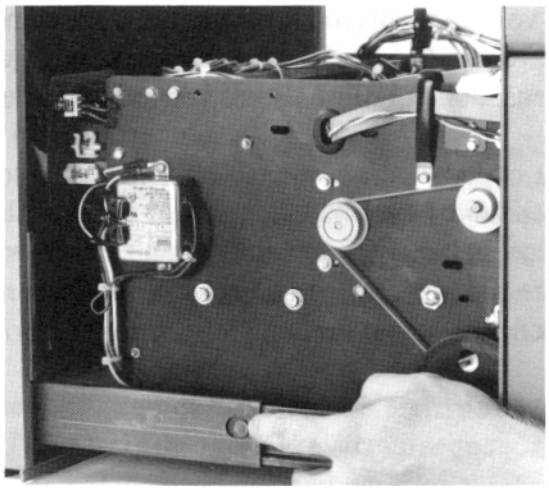
8. Re-connect chassis ground wire.

9. Re-connect multi-pin connectors J-3, J-l and J-5.

Chassis Fully Extended



Release Button On Chassis Slide



3.7 Removing The Portable Instrument Chassis From The Outer Case

The chassis must be removed from the outer case for clutch replacement and adjustment, print head drive motor replacement, chart drive belt adjustment and chart drive motor replacement. These procedures are detailed in the Printing Maintenance section.

1. Program the recorder for standby operation mode in the OPER menu sequence.

2. Turn the power switch off and unplug the power cord from the outlet.

3. Open the top panel as described previously.

4. Unplug the following ribbon cables and harnesses from the digital board:

   a. print head motor (J-2)
   b. chart drive motor (J-7)
   c. print head (J-8) from back of digital board

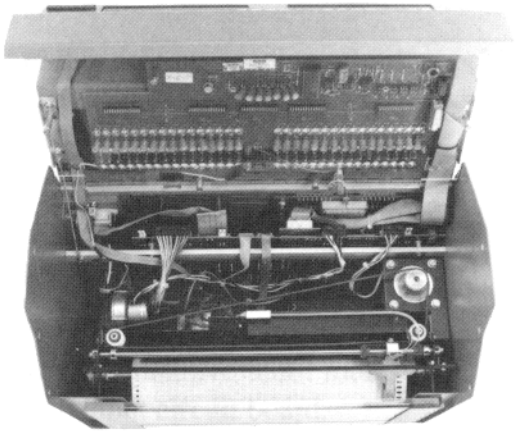
5. Remove two phillips head screws, one from each side panel.

6. Lay the recorder on its back on a suitable workbench and locate six (6) 1/4 inch hex head screws on the bottom of the case. The locations of the screws are shown in the photo below.

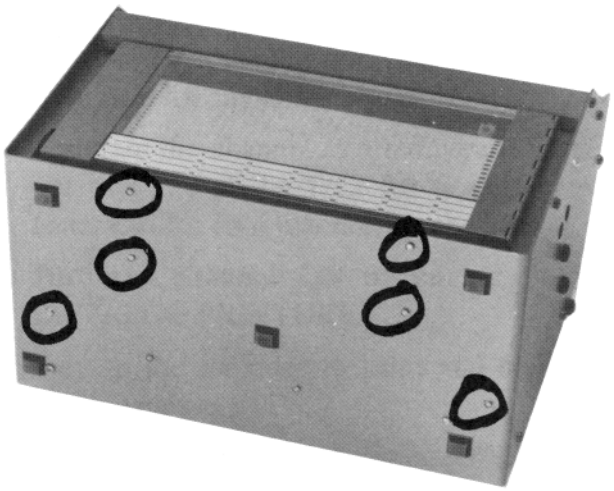
7. Remove these six (6) screws and the main chassis will be released from the outer case.

8. To re-install, reverse the above procedure.

Top Panel Opened



Bottom View of Portable Recorder



4. PRINTING MAINTENANCE

4.1 Overview Of Print Quality Adjustments

The recorders are adjusted at the factory for legible printing on a 200 or 201 print darkness setting. If problems occur with the printing, the mechanical and electronic causes listed below should be investigated before changing the software darkness setting. The possible problems are described in general terms below. Please refer to the following sections for complete details.

- **Print Head Alignment**

Printheads on sliding chassis models have a top to bottom slotted mounting hole. This means the print head can move up and down on the print head mounting arm resulting in missing top or bottom dots. Slightly loosen the mounting screw and move the print head element up or down.

- **Cantilever Weight Adjustment**

An accumulation of ink, dust and/or dirt on the print head can prevent proper paper contact and result in very light printing. Clean the printhead with a cotton swab and trichlor (or similar solvent.)

If the print head becomes clogged often, the pressure which the cantilever weights apply to the upper portion of the print head assembly may be greater than necessary .The print head cantilever weights and the bar which they are connected to can be moved up or down slightly to vary the pressure applied to the print head. Portable models do not have cantilever weights.

- **Print Head Hex Rod Adjustment**

The hex rod should be flush against the inside edge of the front bezel. Also, check to see if the hex rod is not higher at one end than the other. Unplug the printhead cable from the digital board and remove the chart paper. Observe movement of printhead along the hex rod. Both ends of the hex rod should be in the same plane as referenced by the print head side to side travel.

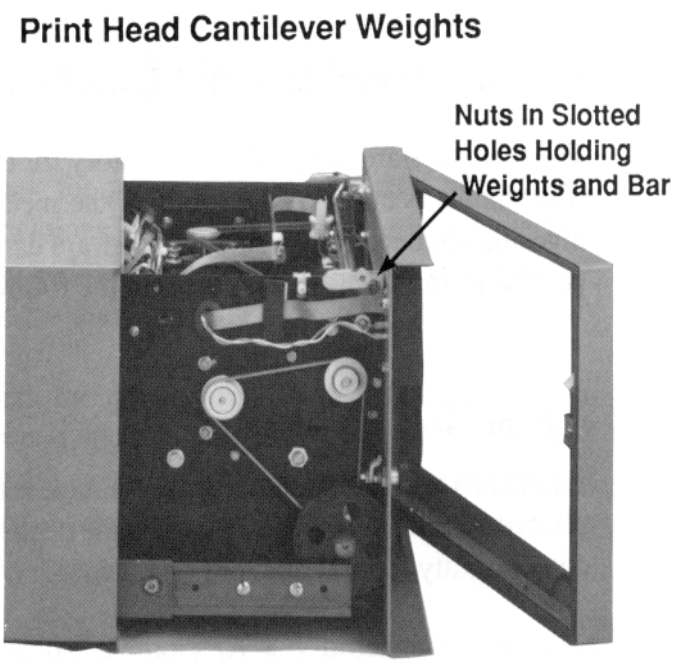
Check the hex rod rubber facing for wear .The entire rod assembly can be replaced or only the rubber facing insert-

- **Missing Dots**

There are three electronic possible causes for missing dots: failed print head driver chips, burned out thermal dot on the print head itself or an open conductor in the print head cable.

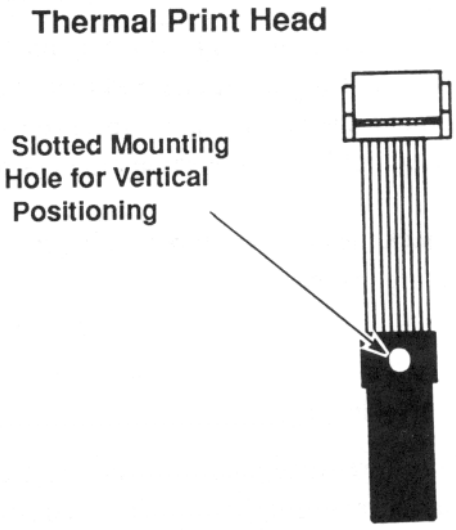
4.2 Cantilever Weight Adjustment For Sliding Chassis Models

Only the sliding chassis types of instruments have cantilever weights.



The print head cantilever weight adjustment will only be necessary if the print quality is too light to read or so dark it appears blurred. Reduce the pressure applied by the cantilever weights to the least amount of pressure that maintains acceptable print quality by loosening two hex head bolts, one on each side of the chassis side plates, and moving the cantilever weights and the connecting bar up or down behind the upper portion of the print head assembly. Move the bar up to apply more pressure to the print head, move it down Lo apply less pressure. The bolts securing the cantilever weights and connecting rod are located just behind the front bezel. The angle at which the cantilever weights are positioned on me connecting bar is set at the factory and should not be changed. Note, however that the angle of the two weights should be the same as referenced by flipping the weights up and using the front bezel as a straight edge.

4.3 Print Head Replacement & Adjustment For Sliding Chassis Models



1. Open recorder front door. Slide out the keyboard and program the recorder to the STANDBY operation mode, which is accessed in the OPER key menu sequence. Turn the power switch off.

2. Remove the 1/4" hex head mounting screw and flat washer. Unplug ribbon connector and remove print head.

3. Install replacement print head by plugging in connector and replacing the flat washer and mounting screw. At this point only snug up the mounting screw until you can ensure that it is properly positioned for accuracy and best quality for printing.

Horizontal alignment of the print head as shown below should be carried out before tightening the mounting screw. Also, as the mounting hole is slotted to allow some vertical movement, check the vertical position of the print head so tops and bottoms of characters are properly printed before tightening mounting screw.

4.3.1 One character printed full scale to check uniformity of print

A single character can be printed across the width of the chart with a one step command in the X key sequence. Use this as a test of full-scale chart printing and to test whether the tops and bottoms of characters are being printed properly.

1. To print a character full scale, press the X key.

2. The left display will show STOP ON LEFT. Press the ENTER key.

3. The left display will show, ADJ RIGHT MARGIN.

4. Type in 199 and press the ENTER key. 199 will remain on the right display. Press any key and press the ENTER key again. The letter or number pressed will print across the chart and will display on the right VFD.

The letter E is a good test character because top and bottom of the character are easily seen, and the proper printhead alignment can be judged by comparing the letter E with the vertical grids on the chart paper. The key that has been pressed will remain on the display and the print cycle can be repeated by again pressing the key followed by the ENTER key.

5. If top or bottom of test character is not being printed, loosen the mounting screw and move the print head up or down. Snug up the mounting screw and repeat the print test.
6. When proper top to bottom print quality is achieved, proceed to section below on print head alignment. The END key must be pressed to exit this test routine.

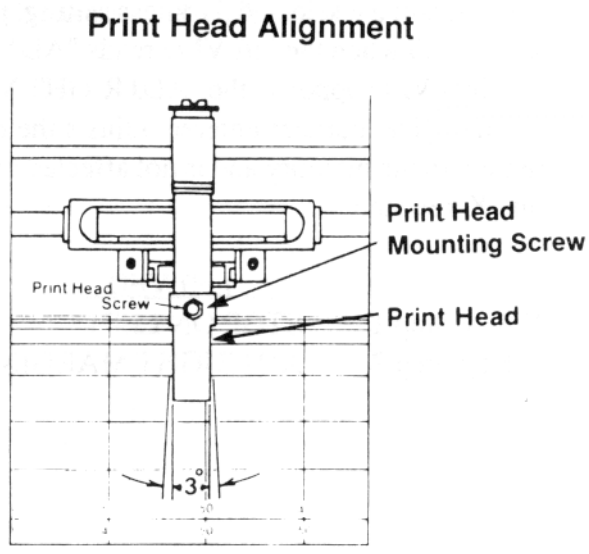
4.3.2 Print head alignment

1. Press the PROG key. Enter any channel to program.

2. Turn TREND PRINTING on.

3. Select and enter VOL T AGE for the type of channel step (PROG step 3).

4. Enter -1 for left margin is, step 8.



5. Enter + 1 for right margin is, step 9.

6. Press the END key.

7. Short the positive negative and ground terminals together (on the rear panel input connection Terminal strip) for the channel programmed in step 1.

8. Press the CHART key. Select and enter TREND for step 1, CHART PRINT. If no chart speed is programmed for step 2, type in 12 (if chart speed unit is in/hour, or 30 if unit is cm/hr) and ENTER. Press the END key.

9. Press the OPER key. Select and enter OPERATE/AUTO. The print head should cycle across the chart and begin to print a trace at the 50% point of the chart. When the print head is aligned properly the trace should print exactly at the middle of the chart.

10. Press the OPER key and place the recorder in STANDBY to make any adjustments, then return to OPERATE/AUTO to check alignment. Tighten the print head mounting screw when alignment is exact.

11. If alignment cannot be accomplished with this procedure, refer to the Mechanical Zero And Span Adjustment procedure.

4.4 Software Adjustment Of Print Darkness

The software print adjustment has four possible settings from light to dark.

(lightest) 200. ...201. ...202. ...204 (darkest) **Note: Do not use 203.**

To program the selected darkness setting, press the X key and then the ENTER key. Type 200, 201, 202 or 204 when the left VFD reads " ADJ RIGHT MARGIN" and ENTER. The number shown on the right VFD opposite the " ADJ RIGHT MARGIN" is the right margin adjustment setting for trend printing. The number entered adjusts the right margin stop over a 10 step range. This setting will remain in the memory and is not affected by this, or any of the other, three digit codes entered under this X key step.

	Left VFD	Right VFD
X Key Step 1	STOP ON LEFT	
X Key Step 2	ADJ RIGHT MARGIN	200
		201
		202
		204

4.5 Print Head Replacement For Portable and 20 Inch Models

The print head is a plug-in component held to the assembly with one mounting bolt. Removal and replacement can be accomplished from the front of the recorder.

1. Program the recorder for STANDBY operation mode and turn the power off.

2. Remove the print head mounting bolt using a 6/32" wrench, nut driver or socket. Take care to retain the star lock washer on the mounting bolt.

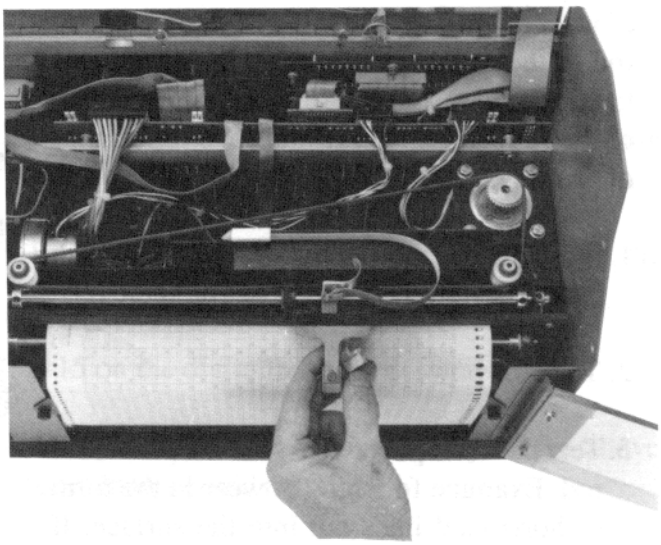
3. Unplug the ribbon connector and remove the print head.

4. Install replacement print head by plugging in the ribbon connector and replacing the mounting bolt.

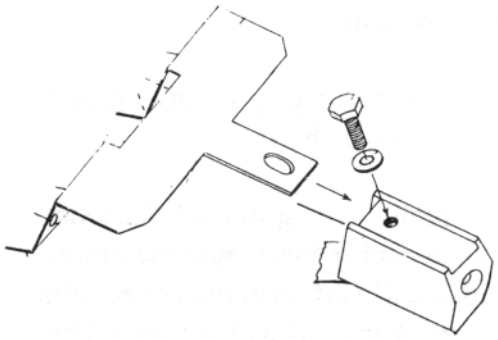
5. Turn the power switch on and program the recorder for OPERATE/AUTO operation mode.

6. Use the software print darkness procedure to achieve the desirable print quality.

Printhead For Portable Model



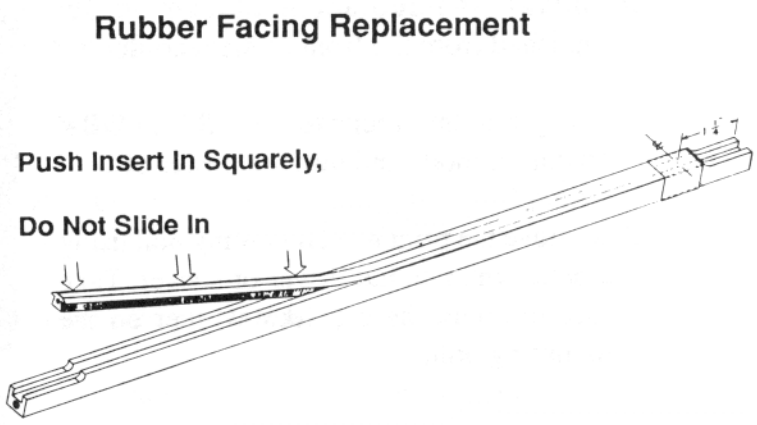
Portable Model Print Head Mounting Detail



4.6 Print Head Rod Rubber Facing Replacement And Adjustment

4.6.1 Rubber facing replacement procedure

Poor print character delineation can be a result of wear on the rubber facing of the print head rod. If the surface of the rubber facing appears to be scored or otherwise worn, replacement of the rubber facing will improve the quality of printing.



1. Program the recorder for STANDBY, which is accessed in the OPER key routine.

2. Turn the power switch off.

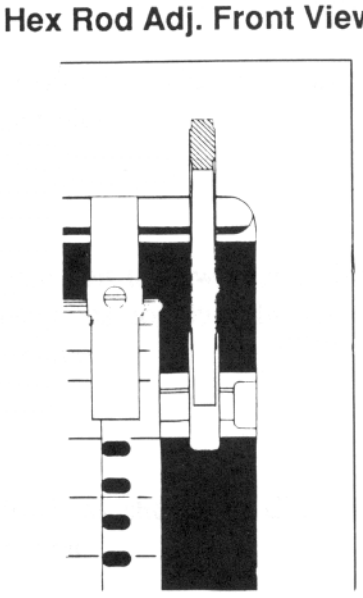
3. Tear the chart paper to expose the print head rod. Examine for signs of wear in the form of horizontal lines cut into the surface. If wear is evident rubber facing should be replaced.

4. Remove print head.

5. Remove piece of teflon tape at print head right side rest position.

6. Remove rubber facing by simply lifting it out of the groove by hand.

7. Push new rubber facing squarely into slot. Do not slide rubber insert into the slotted print head rod. The edges of the slotted print head rod are sharp and will cut the rubber as it slides into the slot resulting in a loose and improper fit.



8. Re-wrap right side print head rest position with 3/4 " x 2 1/4 " length of teflon tape. Wrap tape around rod once with center of tape 1 1/4 " from end of rod.

9. Re- install print head, chart paper and return recorder to service.

4.6.2 Print head hex rod adjustment procedure

If poor print quality persists, it may be necessary to align the print head rod with the following procedure.

1. Turn power on.

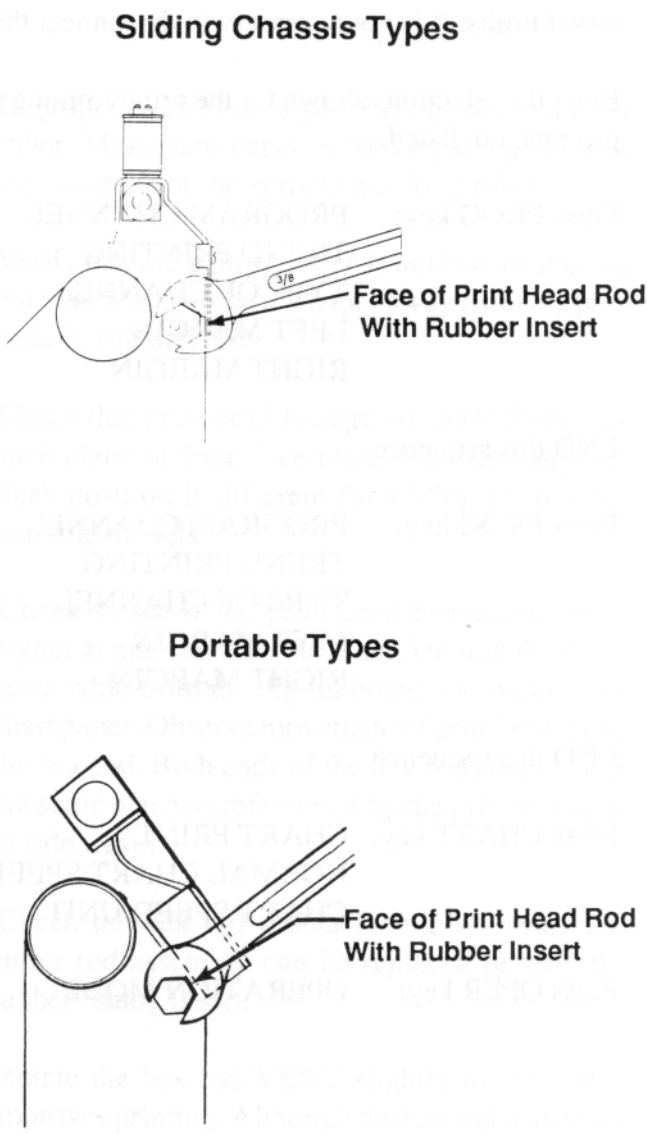
2. Program the recorder to STANDBY in the OPER key menu.

3. Press the X key. The left display will show STOP ON LEFT. Press the ENTER key. The left display will show, ADJ RIGHT MARGIN. Type in 199 and press the ENTER key. 199 will remain on the right display.

4. Press any key and press the ENTER key again. The letter or number pressed will print across the chart and will display on the right VFD. As the character prints, slowly move the hex rod up or down using a 3/8 " wrench as shown in the illustration until legible print quality is achieved.

5. The hex rod is attached to the chassis slide plates by (1) 1/4" nut at each end. If the print head rod becomes loose, hold the rod with the 3/8" wrench and tighten the nuts at both ends of the rod.

6. Press the END key to exit from the print test routine.



Note the difference in rod position for sliding chassis and portable models. The proper position for the face of the print head rod on portable models is at an upward angle to mate with the surface of the print head. This adjustment is very slight for both types of instruments, so apply only a minimal amount of torque to the rod.

4.7 Adjusting Left And Right Limits Of Print Head Travel

Program channels 1 and 2 in the following manner to check the mechanical left and right print head travel limits. It is not necessary to disconnect the channel inputs to carry out this procedure.

Enter the selections shown for the programming prompts listed below. Use the SAME key to bypass prompts not listed.

Press PROG key:	PROGRAM CHANNEL	1
	TREND PRINTING	ON
	TYPE OF CHANNEL	VOLTAGE
	LEFT MARGIN	100
	RIGHT MARGIN	200

END this sequence.

Press PROG key:	PROGRAM CHANNEL	2
	TREND PRINTING	ON
	TYPE OF CHANNEL	VOLTAGE
	LEFT MARGIN	200
	RIGHT MARGIN	100

END this sequence.

Press CHART key:	CHART PRINT	TREND
	NORMAL CHART SPEED	12 (or greater)
	CHART SPEED UNIT	IN/HR
Press OPER key:	OPERATION MODE	OPERATE/AUTO

Channel 1 should be printing at the extreme left edge of the chart paper grid and channel 2 should be printing at the extreme right edge of the chart paper grid. If this is not the case then adjustment is necessary. Continue with the procedures outlined on the following page. The only difference in the procedures for portable and sliding chassis models is the access point for the print head drive motor.

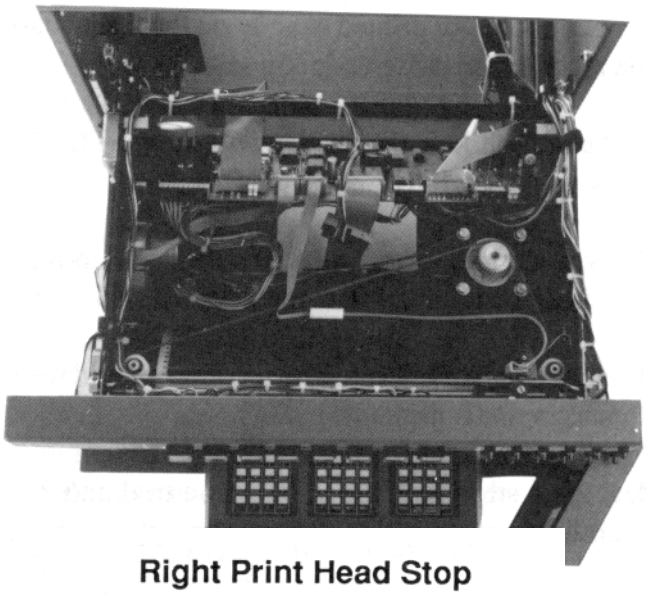
4.7. 1 Mechanical zero adjust (left limit of travel)

If the data points are more than one diameter of a data dot from the left grid line the mechanical zero must be adjusted.

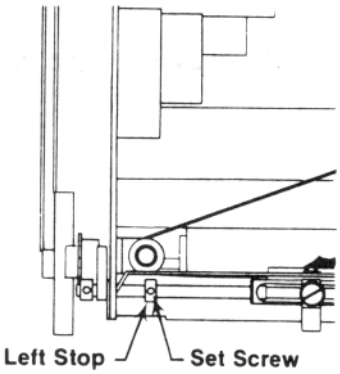
1. Slide out the chassis or open the top panel for access to the print head drive motor and print head assembly. Use a 5/64" allen wrench to loosen the set screws on the left and right stop collars.

2. Slightly loosen the four motor mount nuts of the print head drive motor until motor can be moved within the bracket.

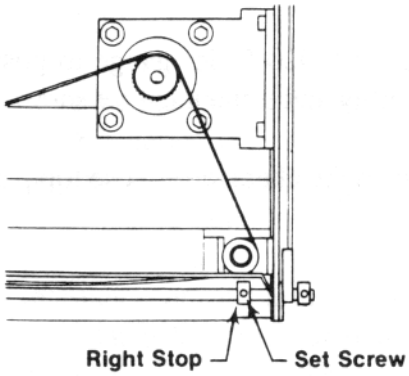
Top View With Chassis Extended



Left Print Head Stop



Right Print Head Stop



3. Move the motor to the right to move the data points to the left, or move the motor to the left to move the data points to the right. When the data points are being printed exactly on the far left edge of the chart paper grid tighten the four motor mount screws.

4. Press the X key while the print head is scanning. The print head will stop at the left margin..

5. Using a feeler gauge tighten the left stop approximately 0.020 inches from the print head assembly.

6. Press the ENTER key to return the print head to normal operation and proceed with the mechanical span adjustment below.

The print head drive motor will be operating. Be careful not to get fingers, hair or jewelry pinched or caught in gear or drive chain.

4.7.2 Mechanical span adjustment (right limit of travel)

If the data points for channe12 are being printed on the extreme right chart paper grid, the right stop collar can be set by programming the recorder to STANDBY and using the 0.020 feeler gauge. If the points are not printed exactly on the right chart paper grid, the span adjustment is made through the recorder software as follows:

1. Press the X key, the display will show STOP ON LEFT. Press the ENTER key. The display will show, ADJ RIGHT MARGIN.

2. Type a number from 1 to 10, which will move the right print margin in steps approximately 1/8 inch or 10mm (a typical recorder uses 632 steps for 10 inches of travel).

3. Press the ENTER key. The recorder should resume printing and you may observe where the right margin dot is printed.

4. Repeat steps 1, 2 and 3. This is a trial and error method so repeat the procedure several times until you can position the trace exactly on the chart paper right margin.

5. When the recorder is printing dots in the proper position along the right margin, press the OPER key and program the recorder for STANDBY. This will stop the print head at the right side rest position.

6. Use the 0.020 feeler gauge to position the right stop collar 0.020" away from the print head assembly and tighten the set screw.

7. Slide in the chassis (or close top panel) and return the recorder to service.

4.8 Print Head Drive Chain Replacement

1. Program the recorder for standby operation mode and turn the power off.

2. Slide out the chassis or open the top panels, depending on the instrument type you have, to gain access to the print head drive mechanical assembly.

3. Remove the drive chain nut and 2 flat washers from the print head assembly:
   - On sliding chassis models you must loosen 2 hex head screws at the rear of the print head assembly for access to the drive chain nut, see illustration.
   - On portable models the drive chain nut is accessible at the back of the print head assembly, see photo.

4. Remove the drive chain from the print head motor drive gear by lifting up at the gear while turning the gear by hand. The chain will disengage as the gear is turned. Remove chain from around both pulleys.

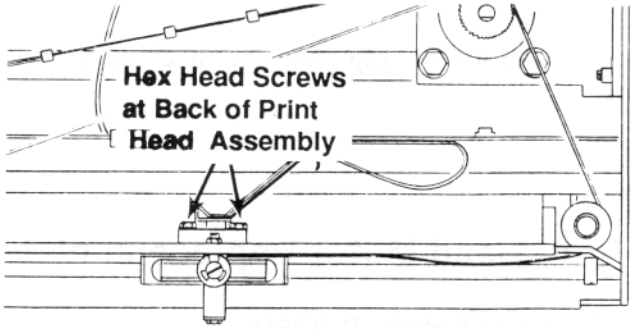
5. Position the mounting hole of the replacement drive chain on the stud on the print head assembly with a flat washer on either side. Hand tighten the drive chain nut.

6. Run the drive chain around both pulleys and engage onto the motor gear while turning the gear by hand.

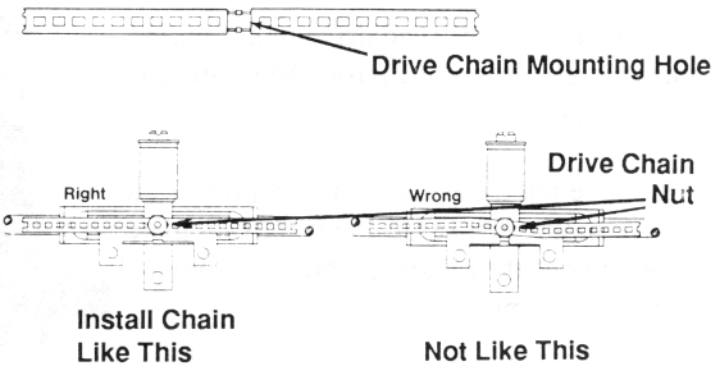
7. Tighten the drive chain nut at the print head assembly taking care to keep the drive chain absolutely straight and parallel to slide rod.

8. The drive chain tension should not need adjustment if the print head motor has not been moved. Check for tension as described in section 4.10. If the drive chain is too tight, printing will be excessively noisy. If the drive chain is too loose characters will be blurred when printed.

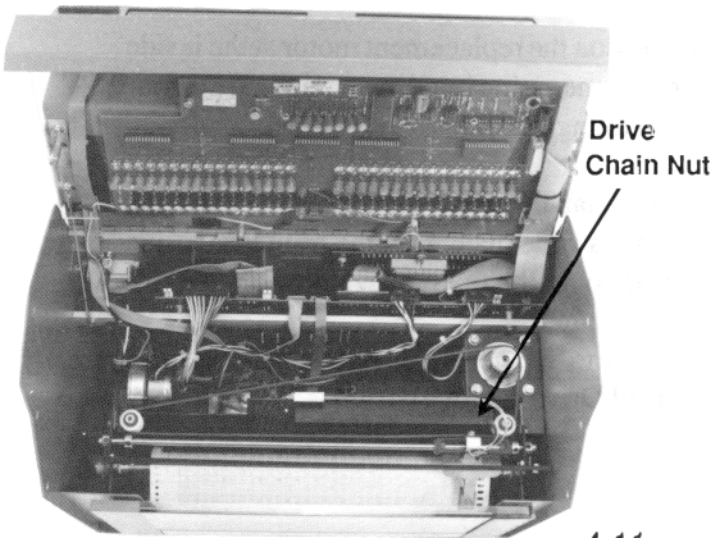
Sliding Chassis Model Print Head



Print Head and Drive Chain Assembly



Drive Chain Nut On Portable Models



9. On sliding chassis recorders, replace the rear section of the print head assembly removed in step 3 above. If necessary, refer to the previous section on print head adjustment and alignment.

10. Refer to section on adjusting the mechanical zero and span before returning the recorder to service.

4.9 Print Head Motor Replacement

4.9.1 Sliding chassis models

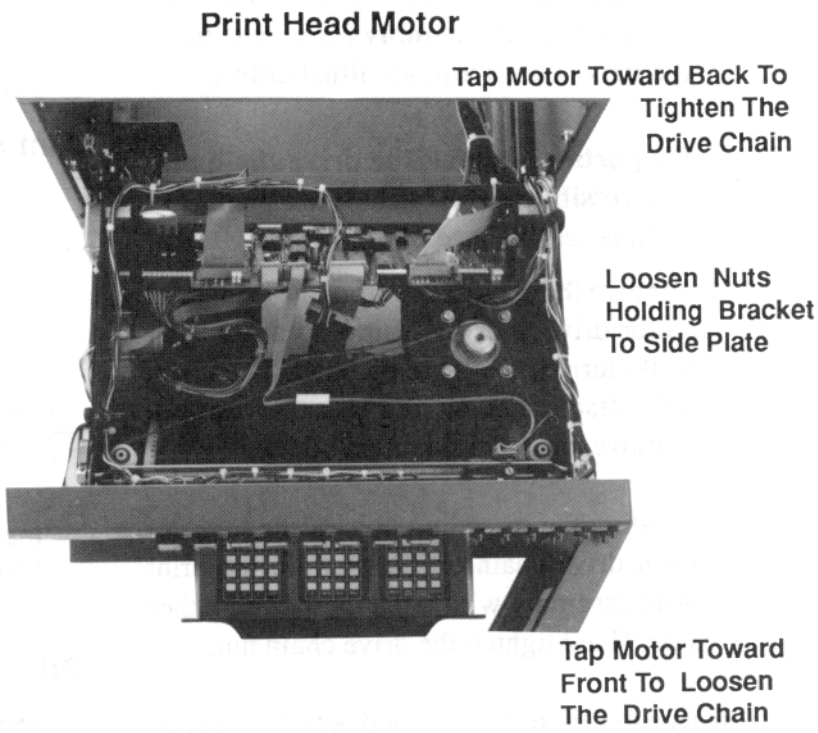
1. Program the recorder to STANDBY in the OPER key menu. Turn the power switch off and unplug the power cord.

2. Slide out the recorder chassis.

3. Remove the print head drive motor wiring harness connector (J-2) from the digital circuit board.

4. Remove the 2 bolts holding the print head drive motor bracket to the right side plate and remove the motor and bracket from the chassis assembly.

5. Remove the print head motor from the bracket by fully unscrewing the four mounting bolts and hardware.


Print Head Motor
Tap Motor Toward Back To Tighten The Drive Chain
Loosen Nuts Holding Bracket To Side Plate
Tap Motor Toward Front To Loosen The Drive Chain

6. Position the replacement motor at the inside of the mounting bracket and tighten the four mounting screws.

7. Reinstall the motor mounting bracket to the chassis slide plate. Run the print head drive chain onto the motor drive gear.

8. Refer to section 4.10, Adjusting The Print Head Drive Chain Tension.

4.9.2 Portable models

1. Program the recorder to STANDBY in the OPER key menu. Turn the power switch off and unplug the power cord.

2. Open the top panel. Locate the print head drive motor on the inside right of the recorder case.

3. Locate two 3/8" hole plugs and 1 phillips head screw on the right side of the recorder outer case.

4. Pop out the 2 hole plugs. Two phillips head screws will be visible inside holes.

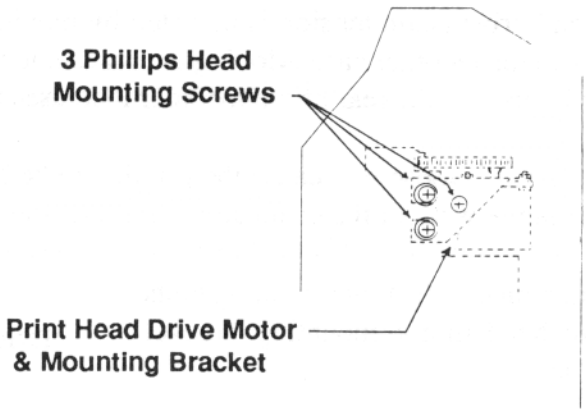
5. Loosen all three of the phillips head screws. The two screws visible with the hole plugs removed hold the print head drive motor mounting bracket to the main chassis. The single phillips head screw on the outer case holds the bracket to the outer case for in- creased stability.

6. With the motor bracket loose, lift off the print head drive chain from the motor gear by lifting up on the chain while turning the gear by hand.

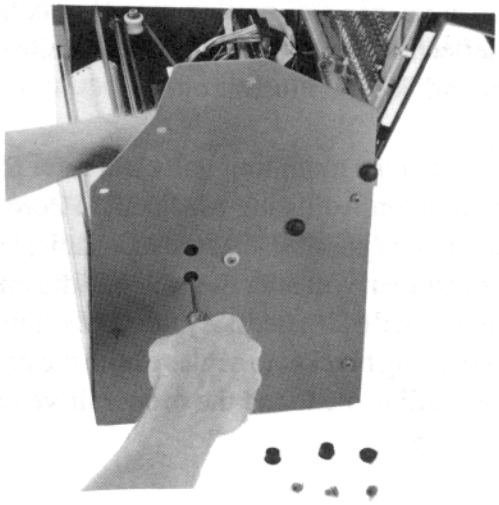
7. Hold the motor and bracket inside the case. Remove all three screws and lift the motor and bracket out of the case. A special gripper-type screwdriver must be used for the screws located inside the hole plugs to prevent them from falling into the inside of the case.

8. Remove the four mounting bolts holding the drive motor to the mounting bracket. Install the replacement motor in the bracket by tightening the mounting bolts in the center of the adjustment slots.

Portable Model Print Head Drive Motor



Loosening The Print Head Motor Bracket



9. Re-install the bracket in the case keeping the screws loose until engaging the drive chain onto the motor drive gear. Again, a special gripper-type screwdriver must be used for the screws located inside the hole plugs to prevent them from falling into the inside of the case. Do not install hole plugs and do not tighten the phillips head screws at this point. Refer to section 4.10 Print Head Drive Chain Tension Adjustment.

4.10 Print Head Drive Chain Tension Adjustment

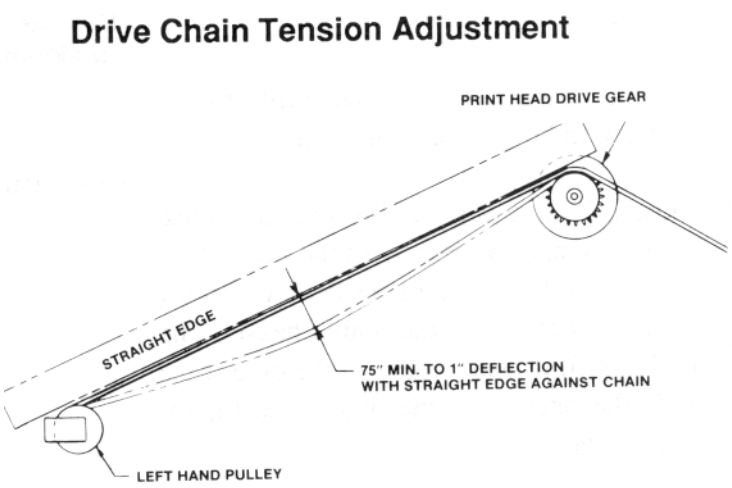
The print head drive chain tension is adjusted by moving the print head motor mounting bracket front to back in the recorder case. Moving the bracket to the front of the recorder decreases tension. Moving the bracket to the rear of the recorder increases tension.

A drive chain that is loose will cause the printing to be blurred. A drive chain that is too tight will result in premature wear of the chain and excessive noise (chattering) when printing.

To make adjustments, the four mounting bolts on the print head motor mounting bracket must be loose.

1. Move the print head motor mounting assembly until the print head drive chain has no more than 3/4" minimum to 1" maximum deflection with a straight edge against the chain. See the illustration.

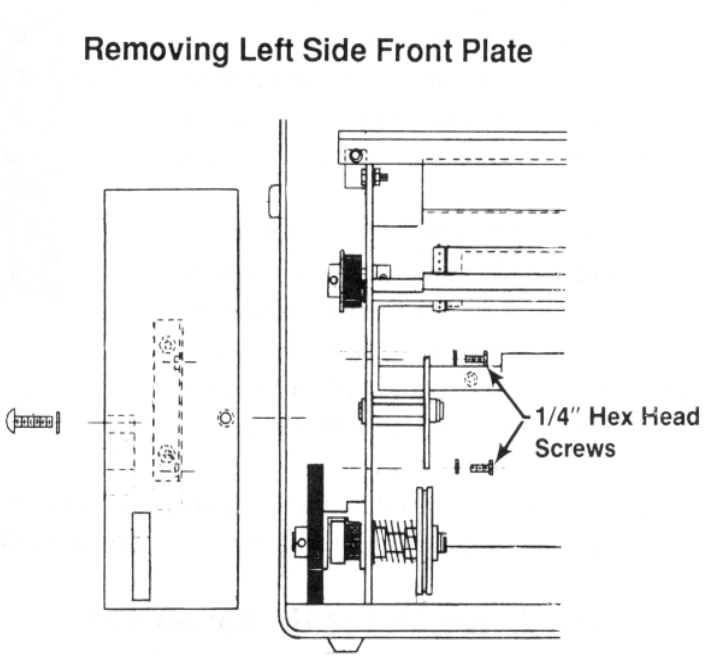
2. Tighten the mounting bolts and refer to the section on Adjusting Mechanical Zero and Span. It is possible that the mechanical zero adjustment will alter the tension adjustment and it will be necessary to reposition the mounting bracket to achieve both the proper zero adjustment and the proper drive chain tension.



5. CHART DRIVE MAINTENANCE

5.1 Removing Left Side Front Plate On Portable Models

Remove the left side plate of the portable recorder in order to replace the chart drive belt or the clutch assembly. These two procedures are detailed later in this section, Chart Drive Maintenance. Please refer to the instructions below if your instrument is a portable model.



1. Program the recorder to STANDBY operation mode in the OPER key menu.

2. Turn the power off and unplug the power cord from the outlet.

3. 0pen the plastic door and loosen the thumbscrews, which hold the writing platen to the front of the recorder. Remove the writing platen.

4. Remove the chart paper rolls.

5. Locate two (2) 1/4 inch hex head screws inside the chart compartment and behind the left side plate as shown in the illustration. Remove these screws and the phillips head screw on the outer left side of the recorder outer case. This will release the left side front plate.

6. Re-install the plate after replacement of the chart drive belt or clutch assembly by reversing the above procedure.

5.2 Chart Drive Belt Replacement

On portable models the chart drive belt is accessible by removing the left front side plate as described in the section above.

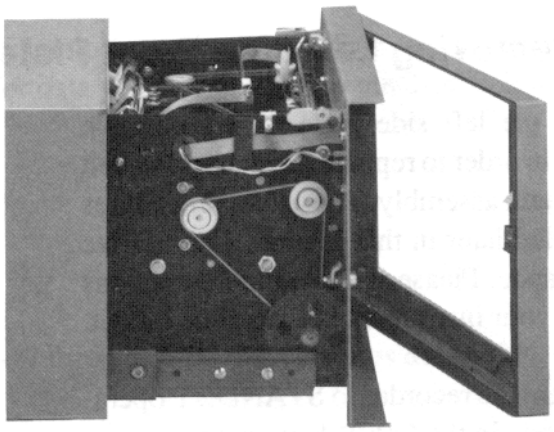
On sliding chassis models the chart drive belt is accessible by sliding out the recorder chassis.

1. Turn the power switch on and program the recorder to STANDBY operation mode. The power should be on in order to use the motion of the chart drive motor to help to seat the chart drive belt onto the motor pulley.

2. Loop the replacement chart drive belt under the thumbwheel and loop it around the chart paper feed roll pulley. The belt teeth must face inside to engage pulley sprockets.

   On the sliding chassis models it is possible to loop the replacement belt over the thumbwheel by pushing it out through the notch in the front bezel, around the thumbwheel and back in through the notch.

Chart Drive Belt



3. Hold the chart drive belt against the bottom of the chart drive motor gear and press the paper advance key. Feed an edge of the belt onto the bottom of the chart drive motor gear and allow the rotation of the motor to pull the belt fully onto the motor gear.

4. Adjustment of the chart drive belt tension should only be necessary if the chart drive motor has been replaced. Adjustment tolerance is shown on the following page.

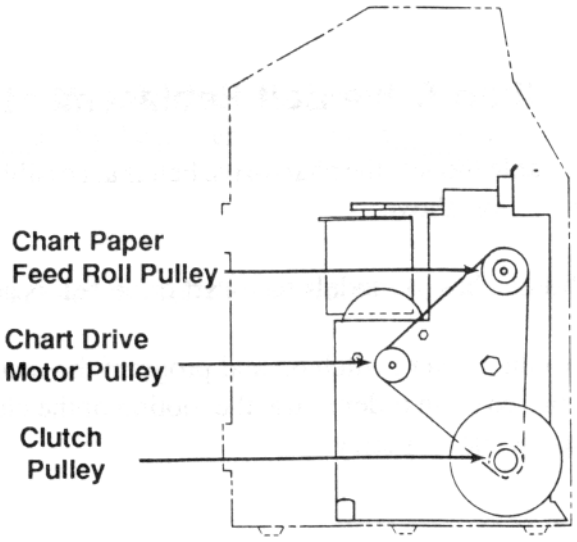
5.3 Chart Drive Motor Replacement

1. Program the recorder to STANDBY operation mode in the OPER key menu.

2. Turn the power off and unplug the power cord from the outlet.

3. For portable models the chart drive motor is accessible by removing the main chassis assembly from the outer case, turn back to the beginning of this section. For sliding chassis models the chart drive motor is accessible by sliding out the recorder chassis.

Motor And Belt On Portable Model



4. Slide the chart drive belt off of the motor gear.

5. Loosen the setscrew on the motor shaft pulley using an allen wrench and remove the plastic gear.

6. Unplug the chart drive motor connector (J-7) from the digital circuit board.

7. Remove the two motor mount bolts holding the chart drive motor to the left side panel of the main chassis and remove the motor.

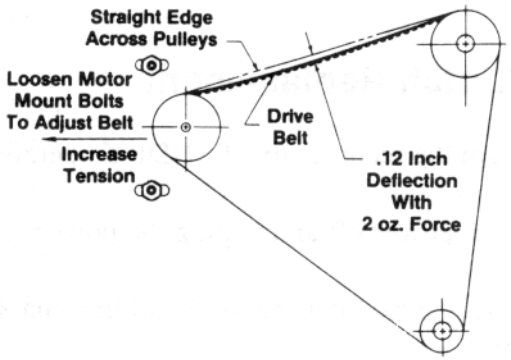
8. Install the replacement motor onto the left side panel keeping it forward in the mounting slots.

9. Install the motor gear onto the shaft.

10. Loop the replacement chart drive belt under the thumbwheel and loop it around the chart paper feed roll pulley. The teeth in the belt must face inside to engage the pulley sprockets. Check chart drive belt tension adjustment.

On the sliding chassis models it is possible to loop the replacement belt over the thumbwheel by pushing the belt out through the notch in the front bezel, around the thumbwheel and back through the bezel notch.

Chart Drive Belt Tension Adjustment



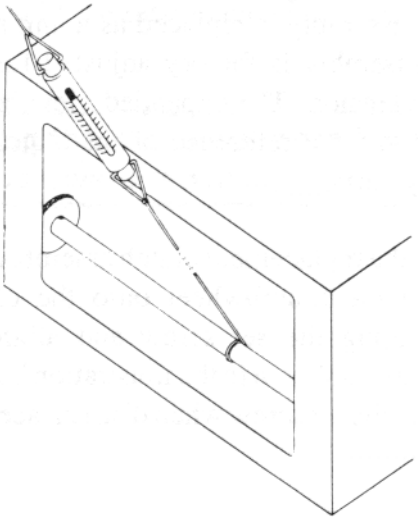
5.4 Chart Drive Belt Tension Adjustment

To adjust the tension on a new or existing belt loosen the two motor mounting bolts and ad- just the motor position until the belt deflection is as shown in the illustration.

5.5 Checking Clutch Torque

Follow the steps in this section to check the clutch torque if paper take-up appears faulty. If the clutch pressure is found to be low, continue with the steps in the following section, which outline replacement of the clutch assembly.

Check Clutch Torque



1. Program the recorder to STANDBY.

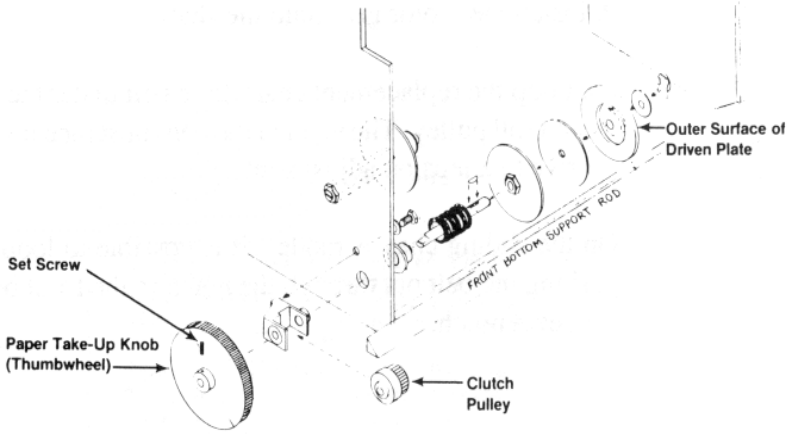
2. Remove the writing platen and both the feed and take-up rolls of chart paper. Strip the paper from the take-up roll and install the cardboard core onto the take-up disc/hubs.

3. Attach one end of a tension gauge to a stationary object and tie a 2 ft. piece of string to the other end.

4. Attach the string to the take-up core and use the PAPER ADVANCE key to roll up the string until the roll stalls.

5. The pressure shown on the tension gauge when the roll stalls should be between 0.5 and 0.75 pounds. If the pressure is low, the clutch assembly should be replaced. Please continue with the steps in the following section.

Expanded View of Clutch Assembly



5.6 Clutch Replacement

1. Program the recorder to STANDBY operation mode in the OPER key menu.

2. Turn the power off and unplug the power cord from the outlet.

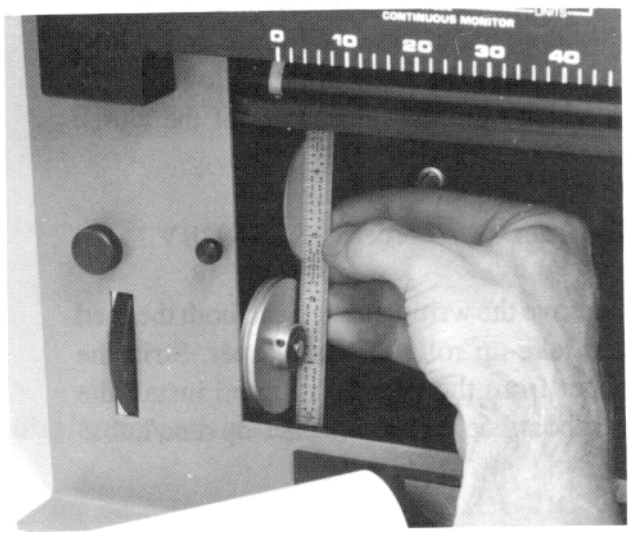
3. Slide out the recorder chassis for sliding chassis model; remove the left side front plate for portable model.

4. Slide the chart drive belt off of the motor pulley.

5. Loosen the setscrew on the thumbwheel (paper take-up knob) and pull the clutch assembly through the hole to the right. The clutch assembly is replaced as a unit since each assembly is factory adjusted for the proper tension. The expanded view below is shown for a reference of the clutch assembly parts.

6. Install the replacement clutch assembly and replace the thumbwheel onto the clutch shaft. Snug the setscrew and align the disc/hubs as shown in the illustration below. Tighten the setscrew when disc surfaces are aligned.

Hub Alignment



6. CIRCUIT BOARD REMOVAL AND REPLACEMENT

All instruments have at least 2, and can have as many as 5, printed circuit boards inside the outer case. All models of instruments have an input circuit board and a digital circuit board. The input circuit board is attached to the backside of the input connection terminal strips. The signals from the connected transducers are accepted at the input board and are sent to the digital board for processing. The digital board contains the microprocessor and the PROM chips which contain the operating software.

Instruments with digital displays have a display circuit board, which controls the large character time of day, continuous monitor and alarm/tag displays. The display board is mounted directly behind the display windows. On sliding chassis models the display and light holder assembly must be removed for access to the display board.

Instruments equipped with the 12 relay option will have a relay circuit board which is typically mounted in a housing attached above the input connection terminal strips. The built -in current source option includes a circuit board, which is mounted on standoffs behind the input board. Connections for the current source terminals will be above the input connection terminal strips.

The procedure for removal and replacement of circuit boards for all instruments is basically the same. The sections which follow attempt to provide a general description for circuit board removal and replacement. Illustrations and descriptions in this section are mostly of the sliding chassis type of instrument. We will attempt to provide specific information for other types of instruments where necessary.

Familiarize yourself with the cable plugs and connections on the board you will replace. You may want to mark or label them before disconnecting. Although the connectors are keyed to prevent plugging them in backwards, some of the connectors are identical which can lead to plugging a cable into the wrong connector. Connector numbers are screened directly on the circuit boards.

Power must be off when removing and replacing electronic components.

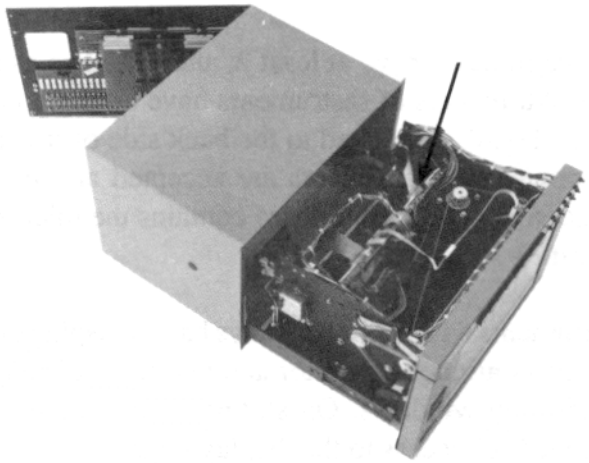
6.1 Digital Circuit Board Removal and Replacement

1. Program the instrument for STANDBY operation mode, turn the power switch off, unplug the power cord and open the outer case for access to the digital circuit board.

2. Familiarize yourself with the cables along the top of the digital board. You may want to mark or label them before disconnecting. Although the connectors are keyed to prevent plugging them in backwards, some of the connectors are identical which can lead to plugging a cable into the wrong connector.

3. Unplug the cable connectors and wiring harnesses. There are black plastic standoffs at the upper left and right comers of the board. Unscrew standoff bolts and remove the digital board from its mounting slots. Different mounting hardware exists for different instrument models. The portable instrument uses plastic standoffs at the top edge of the digital board. Simply squeeze the standoffs with a pair of pliers to release the board.

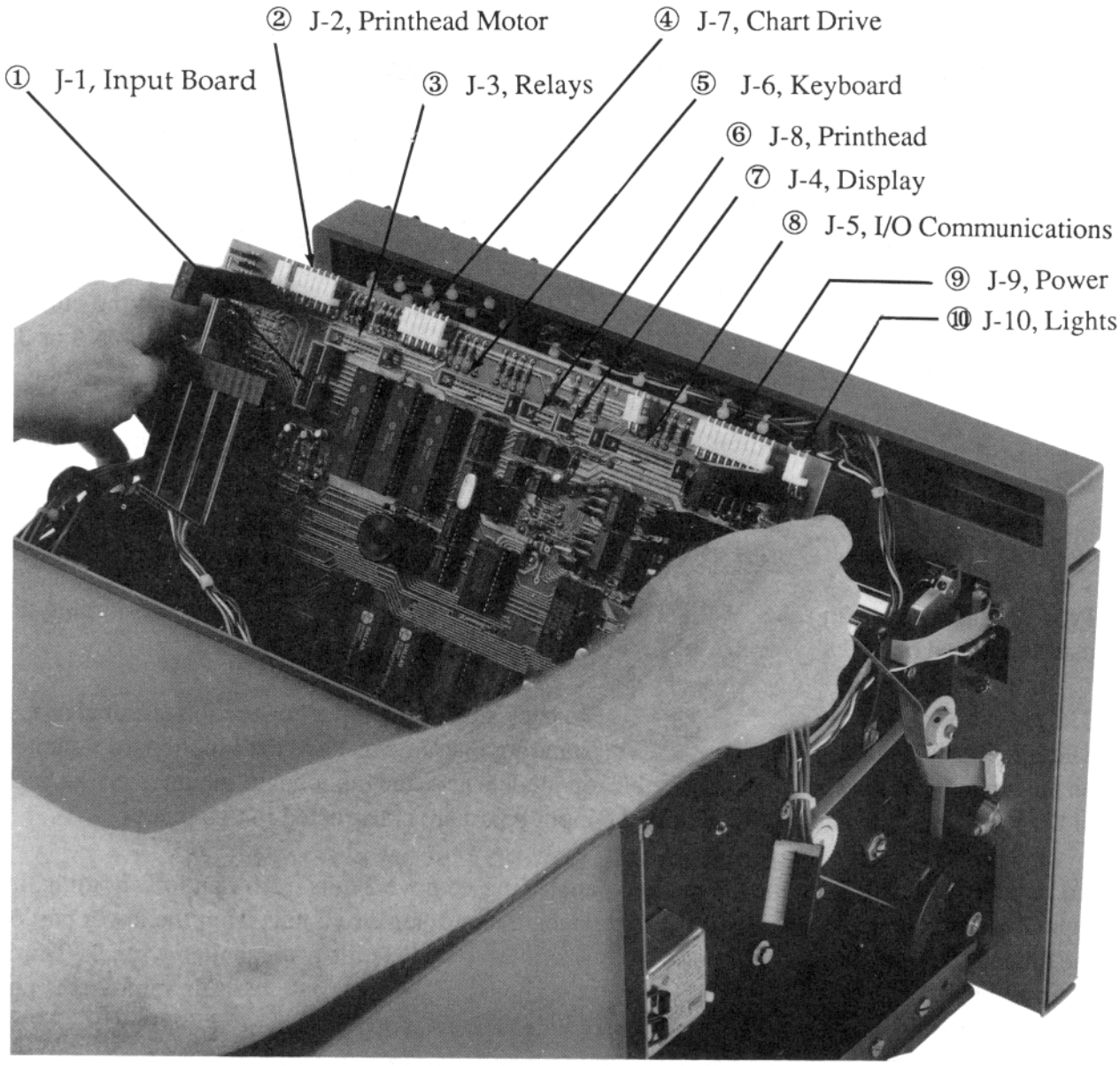
Digital Board In Sliding Chassis Model



4. Install new or repaired digital board in mounting slots. Replace standoff mounting bolts. Plug cable connectors back into mating sockets. Depending on the model and options of your instrument, you may have all or only some of the cables shown in the photo.

5. Clear the instrument memory by pressing the X key and then the ENTER key. Type 77 when the left display reads, ADJ RIGHT MARGIN then press ENTER.

After completing any work on the digital circuit board the instrument memory should be cleared (X key procedure) and the instrument reprogrammed before returning it to service.



1. Blue ribbon connector from input board on rear panel to J -I, Input Board
2. (6) conductor wiring harness from print head drive motor to J-2 Print Head Motor
3. Blue ribbon connector in cable run from relay board on rear panel to J-3, Relays.
4. (6) conductor wiring harness from chart drive motor to J- 7, Chart Drive Motor

5. Blue ribbon connector from keyboard to J-6, Keyboard. Also, if instrument is equipped with function pushbuttons, 6 conductor wiring harness from function pushbuttons plugs into cable connector on keyboard cable
6. Small blue ribbon connector from print head to J-8, Print Head
7. Small blue ribbon connector from display board to J-4, Display
8. Blue ribbon connector from the RS-232 port to J-5, I/O communications
9. (9) conductor wiring harness from transformer to J-9, Power
10. (2) conductor wiring harness from chart lights to J-10, Lights

6.2 Current Source Board Removal And Replacement

1. Program the instrument for STANDBY operation mode, turn the power switch off, unplug the power cord and open the outer case for access to the current source circuit board. The current source board is always mounted on the input circuit board in piggyback fashion on all models of instruments.

2. Unscrew and remove the bolts and plastic washers from the standoffs, which hold the current source, board in place. The number will vary depending on whether the board is an 8, 16 or 32 channel version.

3. Unplug the blue ribbon connectors at the top of the board and the power connector wiring harness at the bottom. Remove the current source board.

6.3 Input Circuit Board Removal and Replacement

1. Program the instrument for STANDBY operation mode, turn the power switch off, unplug the instrument and open the outer case for access to the input circuit board.

2. The input board is permanently attached to the backside of the input connection terminal strips. Sliding chassis models, rack mount and freestanding instruments have the input board mounted on the hinged rear panel. Portable and tabletop models have the input board mounted on the back of the top panel. The panels, which hold the input board, are constructed in two pieces.

3. To remove the board from the hinged rear panel: first, remove 2 nuts from standoffs holding the input board to the upper section of the rear panel. Second, remove 2 nuts from the lower part of the hinge. To remove the bottom nut you may need to hold the bolt with an allen wrench. Third, remove 2 nuts holding a short metal strap at the side opposite the hinge. Fourth, remove the nut at the bottom of the board, which connects a ground wire to the chassis assembly.

4. Disconnect the blue ribbon cable connection from input board to digital board (J-101).

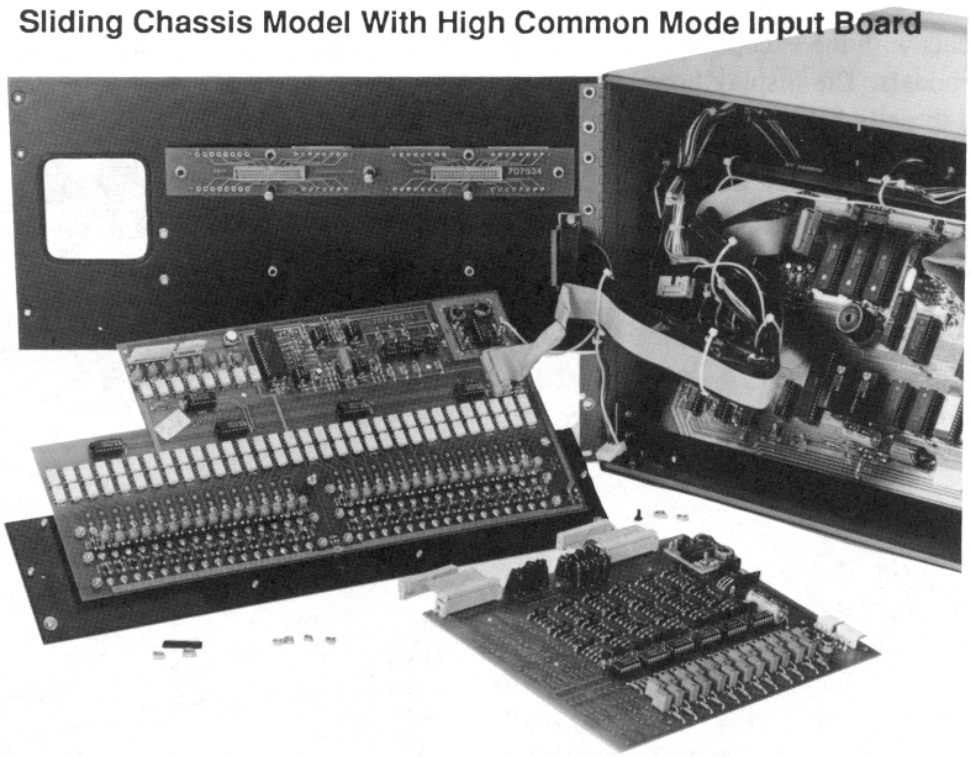
5. To remove the board from the top panel: first, unplug the 3 cables from the back of the keyboards. Unplug J-4 display board from the digital board. Second, unscrew the nut holding the top panel-retaining strap. Remove the nuts holding the top panel to the hinge.

6. Remove the top panel to a suitable workbench. Remove the plastic heat shield. Remove the nuts holding the angle brackets on each side and install the angle brackets on the replacement board. Install the plastic shield on the new board.

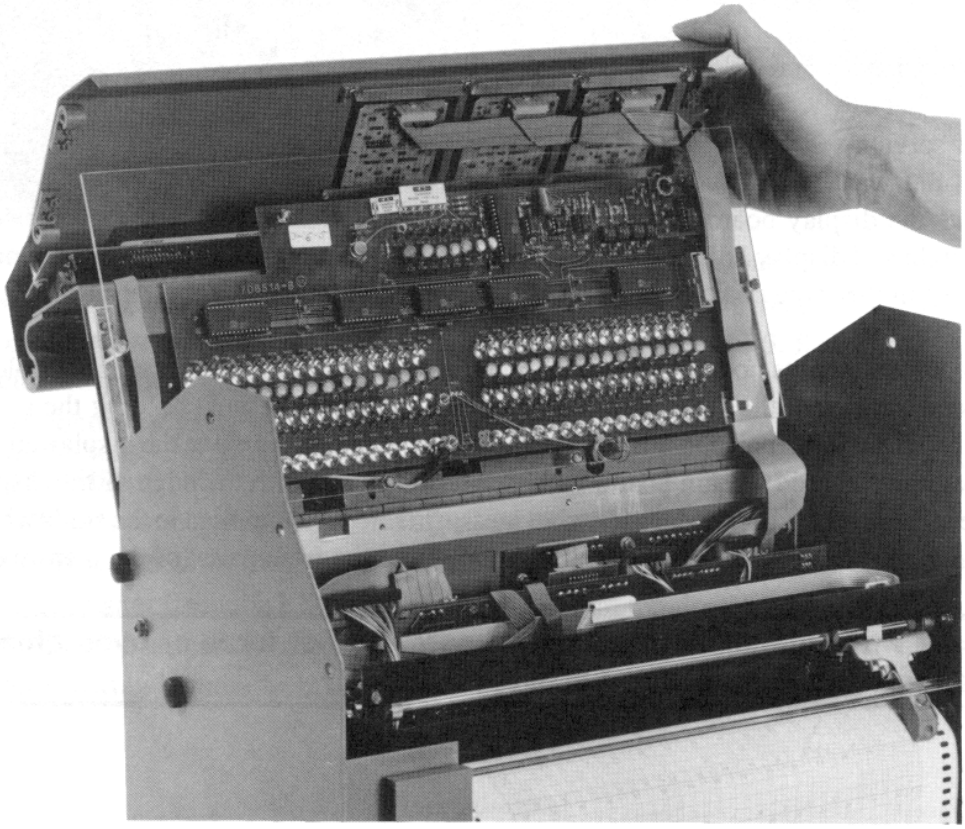
7. Re-install replacement input board by reversing the above procedure.

8. After installing a new standard input board, verify that the cold junction compensation pot is adjusted properly. High common model input boards are self-adjusting.

Sliding Chassis Model With High Common Mode Input Board



Portable Model Showing Standard Input Board

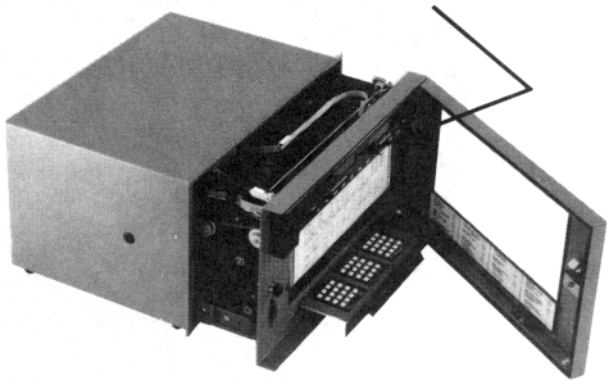


6.4 Display Board Removal and Replacement

The display board is easily accessible on most instruments with the exception of the sliding chassis models. The display board is always mounted directly behind the display viewing windows. To remove the display board on all instruments except the sliding chassis models, simply remove the nuts holding the board to standoffs and unplug the small blue ribbon connector to remove the display board.

On sliding chassis models the front panel display and light holder must be removed for access to the chart lights and the display circuit board.

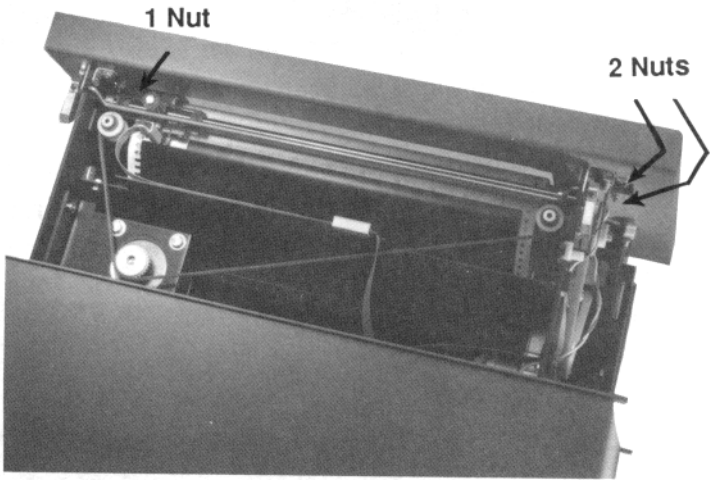
Front Panel Display and Light Holder



1. Program the instrument for STANDBY, turn the power switch off, unplug the power cord and slide out the chassis.

2. Unplug the red and white wire chart light connectors, the display board blue ribbon connector and remove three (3) nuts as shown in the photo.

Display and Light Holder Removal Detail



3. With the display and light holder removed, chart lights can be replaced or the display board serviced. Remove (3) nuts and (3) nylon flat washers that will be visible to remove the display board totally from the chart light and display holder. When installing a replacement board make sure nylon washers are replaced in the same position to isolate the display board from the mounting studs.

4. There are 3 kep nuts positioned on the mounting studs of the display and light holder, which are intended to prevent the studs from being pulled out when the nuts holding the assembly to the front panel are tightened. Do not remove these nuts when you remove the display and light holder. The kep nuts should remain positioned on the studs even with the edge of the display and light holder. These nuts will prevent excessive pressure from being applied to the studs when tightening the three nuts holding the display and light holder to the front panel of the instrument.

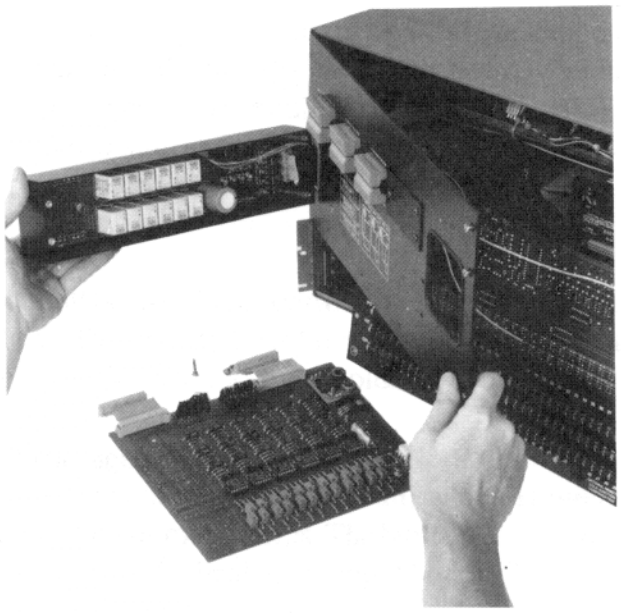
Use care when installing the display board. Do not force or over tighten any nuts as this can damage the VFDs.

6.5 Relay Board Removal and Replacement

The relay board is contained in a metal housing mounted to the instrument case with 4 hex head bolts. On sliding chassis, rack and free standing models the current source board and the input board must be removed for access to the 2 bolts on the hinge side of the rear panel.

The relay board is connected to the digital board with a blue ribbon cable to J-3, Relays. Power for the relay board comes directly from the instrument's transformer.

Relay Circuit Board In Housing



7. TROUBLESHOOTING GUIDELINES

If the recorder appears inoperative, make the following preliminary checks before proceeding with troubleshooting:

- **A.C. power plug is plugged into a live socket.**
- **Power switch is on.**
- **1Amp, Slo-Blo power line fuse is not blown (open).**

Before attempting any repairs to the instrument, check for proper power supply voltages. Without the regulated voltages applied, the instrument circuits will not function normally.

7.1 Power Supply Checks

The first step to take in attempting to repair the instrument is to check the power supply voltages.
The following is a list of voltage checks to be made on the digital board with respect to common ground. See the power supply schematic, drawing #799083.

a. + 12V @ output of E-38 regulator.
b. +15V @ output of E-34 regulator.
c. -15V @ output of E-19 regulator.
d. +12V @ output of E-33 regulator.
e. -12V @ output of E-36 regulator.
f. +5V @ output of E-20 regulator.

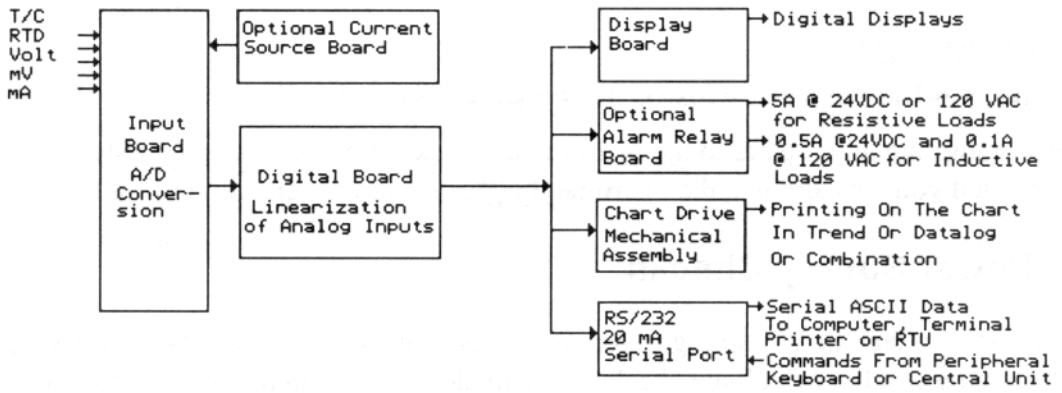
The following checks are made on the input board. See input board schematic, drawing #799082.

g. + 15V across C155.
h. -15V across C156.

Should the troubleshooting procedure indicate a possible defective IC chip we recommend switching the chip with an identical chip from a different section of the instrument, a different unit or a known good chip from another source.

Turn the instrument power switch off and unplug the AC power cord before removing any chips or making any electronic hardware repairs.

7.2 Basic Block Diagram


T/C
RTD
Volt
mV
mA
Input Board
A/D Conver-sion
Optional Current Source Board
Digital Board
Linearization of Analog Inputs
Display Board
Digital Displays
Optional Alarm Relay Board
5A @ 24VDC or 120 VAC for Resistive Loads
0.5A @24VDC and 0.1A @ 120 VAC for Inductive Loads
Chart Drive Mechanical Assembly
Printing On The Chart In Trend Or Datalog Or Combination
RS/232 20 mA Serial Port
Serial ASCII Data To Computer, Terminal Printer or RTU
Commands From Peripheral Keyboard or Central Unit

7.3 Problems Usually Associated With The Input Board

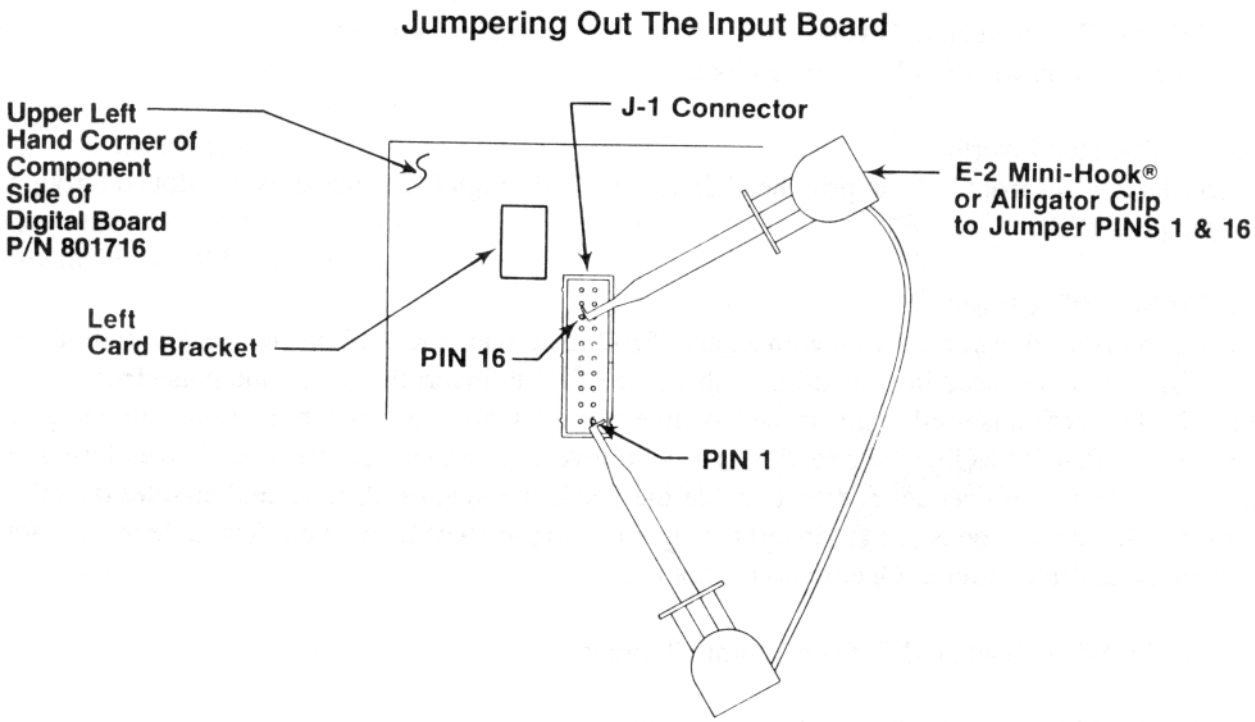
1. No data being recorded from 1 or more channels.
2. No data being recorded from any channel.
3. Inaccurate data from 1 or more channels.
4. Inaccurate data from all channels.
5. Data from active channels is printed against right or left margin.
6. Print head stops moving.

7.4 Problems Usually Associated With The Digital Board

1. Command entry inoperative.
2. Chart paper drive inoperative or erratic.
3. Print head drive inoperative or erratic.
4. All or part of print character is missing.
5. Intermittent reset. (crash)
6. ASCII output or input inoperative.
7. Time and/or date loss.
8. Memory loss.
9. Blows fuses.
10. Vacuum fluorescent display (VFD) not lit or displaying unusual characters.

7.5 Operation Without Input Board For Diagnostics

The input board can be separated from the other circuitry and the instrument operated to help to isolate problems. See the illustration and connect a jumper between pins 1 and 16 of the J-1 connector on the digital circuit board. The instrument may now be programmed for the sawtooth input source and operated without any external inputs.


Jumpering Out The Input Board
Upper Left Hand Corner of Component Side of Digital Board P/N 801716
J-1 Connector
E-2 Mini-Hook® or Alligator Clip to Jumper PINS 1 & 16
Left Card Bracket
PIN 16
PIN 1

7.6 General Description Of IC Functions

E-l: 74LSOOPC Quad NAND Gate
Used in conjunction with X-1 the 1.0MHz crystal oscillator, the system clock. One gate is used for the R/W RAM line, one gate is used as an inverter for data pulses being fed to pin 1 of E-28 that drives dot #7 on the print head.

E-2: 74LSOOPC Quad NAND Gate
Used in conjunction with E-17, real time clock.

E-3: 74LS04 Hex Inverter
Inverts data pulses from E-14 to print head drivers E-27 through E-25 that activates dots 6 through 1 of the print head.

E-4: 74LSO4 HEX Inverter
One section is used in conjunction with a gate of E-2 to activate the read line of clock chip E-17 at pin 2. One section is used in conjunction with a gate of E2 to invert the ready line pulse from pin 4 ofE-17. One section is used to invert the R/w line from E10 and used in conjunction with one gate of El for the R/w RAM line. One section is used to invert the signal from the reset line and used to enable the section of decoder E-8 that enable the PROMs E-11, E-12, E-13 and enables decoder E-9 at pin 4. One section is used to invert the signal from pin 39 ofE-16 to pin 6 ofE-28 to activate the print head driver circuit. One section is not used.

E-5: 4093 CMOS Quad NAND Gate Schmitt Trigger.

E-6: 74HC 14 Hex Schmitt Trigger Inverter
Used in conjunction with E-14, E-15, and E-16 interface adapters.

E-8: 74LS139 Dua12-4 Decoder
One half monitors address lines 9 and 10 and enables VIAs: E-14, E-15, E-16 and clock chip E-17. The other half monitors address lines 14 and 15, enables EPROMs E-11, E-12, E-13 and decodes E-9.

E-9: 74LS138 3-8 Decoder
Monitors address lines 11,12 and 13. Enables E-21 and E-22 RAM chips and one halfofE-8 that enables VIAs and clock chip. (The other half of E-8 is enabled by the power/reset line that is invected through one section ofE-4.)

E-10: 6502
8 bit microprocessor Regulates all operations of the instrument, based on the sequence of instructions the it is executing.

E-11: 27128 PROM "A" Program
E-12: 27128 PROM "B" Program
E-13: 27128 PROM "C" Program
Programmable read only memory chips that control the system operating software.

E-14: 6522 Variable Interface Adapter
Controls the print head, sends keyboard information to the microprocessor and controls the alarm buzzer.

E-15: 6522 Variable Interface Adapter
Controls chart drive and print head motors, controls left VFD. Sends information from input board to microprocessor.

E-16: 6522 Variable Interface Adapter
Controls relay board and right VFD.

E-17: MM58167 Real Time Clock
Functions as a real time clock-calendar in our bus-oriented microprocessor system. The device includes an addressable latch for alarm functions and 2 interrupt outputs. A power down input allows the chip to be disabled from the outside for standby low power operation. The time base is generated from a 32,768 Hz crystal controlled oscillator.

E-18: MOS6551 ACIA Universal Asynchronous Receiver-Transmitter
Automatically clocks serial data in or out and implements parity, stop bit, bit rate, and word length along with all standard configurations for a modem. It also has the capability to convert 8 bit parallel data to 8 bit serial data to 8 bit parallel data and 8 bit serial data to 8 bit parallel data.

E-19: 7915 Negative 15V Regulator
Provides regulated -15V to the input board.

E-20: LM309K Positive 5V Regulator
Provides regulated +5V to the digital board.

E-21: SRAMHM6116-4 E-22: SRAM
HM6116-4
CMOS Random Access Memory chips used by microprocessor (6502) for temporary memory

E-23: CMOS SRAM Dallas 1220Y Static RAM
E-24: CMOS SRAM Dallas 1220Y Static RAM
CMOS Random Access Memory chips used for memory storage of user programmable parameters. Retains memory with power shut down (lithium battery built in).

E-25: LM75452 Driver
E-26: LM75452 Driver
E-27: LM75452 Driver
E-28: LM75452 Driver (modified with 470 ohm resistor)
Dual NAND gates used as print head drivers.

E-29: 4N37 Opto-isolator
Provides optical isolation in the receive branch of the current loop.

E-30: 4N37 Opto-isolator
Provides optical isolation in the transmit branch of the current loop.

E-31: DS1489 RS-232 Receiver
Converts RS-232 signals to TTL signals.

E-32: DS 1488 RS-232 Driver
Converts TTL signals to RS-232 signals.

E-33: 7812 Regulator
Provides regulated + 12 volts to RS-232 communication circuits.

E-34: LM7815 Positive 15V Regulator
Provides + 15V to the input board.

E-35: 74LS 244 Octal Buffer

E-36: 7912 Regulator
Provides regulated -12 Volts to the RS-232 communications circuits.

E-37: 4N37 Opto-Isolator Provides optical isolation of the digital input signal.

E-38: LM7812 Positive 12V regulator
Provides + 12V to the print head.

E-101: HI1-507A-5MUX
E-102: HI1-507A-5MUX
E-103: HI1-507A-5MUX
E-104: HI1-507A-5MUX
E-105: HI1-507A-5MUX Analog multiplex switch.
E-106: LHOO70
10V Reference

E-l 07: LM335Z Temperature transducer
Provides cold junction compensation reference.

E-108: HI1-507A-5MUX Analog Multiplex switch.

E-109: OP-07CS OP-AMP
Gain amplifier.

E-110: LF353N DUAL OP-AMP
E-111: LF353N DUAL OP-AMP
A/D Converter.

E-112: 4N37 Opto-Isolator
E-113: 4N37 Opto-Isolator
E-114: 4N37 Opto-Isolator
E-115: 4N37 Opto-Isolator
E-301: MCA 231 Opto-Isolator
E-302: MCA 231 Opto-Isolator
E-303: MCA 231 Opto-Isolator
E-304: MCA 231 Opto-Isolator
E-305: MCA 231 Opto-Isolator
E-306: MCA 231 Opto-Isolator
E-307: MCA 231 Opto-Isolator
E-308: MCA 231 Opto-Isolator
E-309: MCA 231 Opto-Isolator
E-310: MCA 231 Opto-Isolator
E-311: MCA 231 Opto-Isolator
E-312: MCA 231 Opto-Isolator
Provides optical isolation between relays and E-16.

E-401: 10937 Display Controller
Controls left section VFD.

E-402: 10937 Display Controller
Controls right section VFD.

8. PROBLEMS AND POSSIBLE CAUSES

8.1 Printing Problems

Print head does not move when power is first applied:

1. Open the chassis and check that print head cable is not binding on paper hold down plate.

2. Check print head drive chain.

Missing sections of characters in datalog printing and/or spaces occur in trend recording.

1. Check Driver chips:
   Four print head driver chips on the digital board power the seven dot print head. Dot position is referenced from the bottom of the printed character to the top and is associated with the respective driver chip as follows:

Dots 1 and 2	E-25
Dots 3 and 4	E-26
Dots 5 and 6	E-27
Dot 7	E-28

   E-28 also powers the enable line for all the print head dots. If E-28 is defective, it is possible that no dots will be printed. Replace the chips associated with the missing dots.

2. Check dot resistance on the print head. If the resistance of the related dot is measured to be open the dot is burned out. Traces can be seen on the back of the print head body. Replace the print head if a dot is open.

3. Check for open in the cable. If a dot is missing at only one spot on the chart and that spot repeats from line to line there is probably a broken wire in the print head cable. Replace the cable.

4. Check print head position on mounting arm. Print heads on sliding chassis instruments have a slotted mounting hole that can move along the print head arm resulting in missing top or bottom dots. Slightly loosen the mounting screw and move the print head element up or down.

	5. Check for bent print head arm. Look at print head arm. Print head element should rest directly and flat on chart paper. 6. Check hex rod rubber facing for wear. Replace rubber-facing insert on hex rod if it is scored and worn.
Print head prints a solid black line across the chart in trend or datalog mode of printing.	1. E-25, E-26, E-27 or E-28 defective.
Overall light print quality.	1. Check the following mechanical adjustments: print head adjustment, print head cantilever weight adjustment, print head rod rubber facing replacement and print head rod adjustment. 2. An accumulation of ink, dust and/or dirt on the print head is preventing proper paper contact. Clean with a cotton swab and trichlor, alcohol or similar solvent. 3. Position the cantilever weights approximately horizontal unless that leaves a black background streak. Lower the weights until the black streak is gone. 4. Enter new software print darkness or "dwell time" adjustment. Only after all of the mechanical and other electronic causes for poor print quality have been examined should the higher number print darkness settings be programmed on your instrument. Higher settings mean more heat and a decreased life span for the printhead dots. See software print darkness adjustment in the operating instructions manual.

	5. The common return on driver E-28 may have failed open, replace E-28.
Poor side to side print quality.	1. Improper alignment of paper on sprocketed drive roller. Make sure paper is feeding straight across the two ends of the sprocketed drive roller. 2. Verify that the writing platen is not bent or sticking out which may force the paper away from the print head hexagonal rod. 3. Check that print head hexagonal rod is flush with back plane of front faceplate. Note that angle of flush position is different for sliding chassis and portable models. 4. Check to see if the print head hexagonal rod is higher at one end than the other. Unplug the printhead cable from the digital board and remove the chart paper. Observe movement of printhead along the hex rod. Both ends of the hex rod should be in the same plane as referenced by the printhead side to side travel. 5. Check the hex rod rubber facing for wear. The entire rod assembly can be replaced or only the rubber facing insert. 6. Rotate the hex rod VERY slightly to see if that improves printing. Although the hex rod may seem stiff and rigid, you can twist one end with respect to the other. Therefore, try adjusting the end where the print is weak or missing.
Print head prints solid black line across paper.	1. The respective driver (E25 -E28) for that dot has failed in the shorted position. STOP THE PRINTING! Failure to correct this condition will cause failure of the print head dot making the replacement of the print head necessary.

Instrument prints software version identification RECORDER/DATALOGGER SOFI'WARE VRS... when power is first applied, but no further data is printed and print head does not move.	1. Check CHART key programming to verify that a chart speed or datalog interval has been entered. The instrument will not print at a speed or interval setting of 0. 2. Check OPER key programming. The recorder prints data only in the OPERATE/ AUTO mode.
Print head does not move, digital displays do not light and alarm buzzer beeps continuously when recorder is turned on.	1. Check that all IC chips are firmly seated in sockets, especially E-11, E-12, and E-13 on the digital board. 2. Check that all ribbon connectors and wiring harness plugs are properly seated in connectors. 3. Check all power supply voltages. 4. E-1, E-10 or E-35 on the digital board may be defective. 5. X-1, the crystal on the digital board, may be defective. NOTE: The alarm buzzer may be deactivated during repair by disconnecting one end of R-48 from the digital board. Other circuits will not be affected.
Print head stops moving.	1. Unplug input cable from the digital board (J-101) and jumper pins 1 and 16 of the receptacle. If print head then scans across chart smoothly, E-112 on the input board may be shorted.
Print head moves erratically across chart paper, does not scan entire width of paper and print out is unintelligible.	1. Print head drive belt is defective.

	2. Gear on print head motor shaft is loose. 3. One or both pulley rollers are binding. 4. Q-5, Q-6, Q- 7 or Q-8 on the digital board are defective. 5. D-13, D-14, D-15, orD-16 on the digital board are shorted. 6. R-19, R-28, R-29, R-30, R-31, or R-57 on the digital board are open. 7. E-15 on the digital board is defective. 8. An open solder connection to any of the above components could exist. 9. Print head motor may be defective.
No data points or characters are being printed on the chart but print head is scanning.	1. Check that all IC chips are fully plugged into sockets. 2. Check that print head cable (J-8) is plugged in securely. 3. On sliding chassis models, rest your finger on the print head and apply slight pressure as it scans. If dots are printed, make mechanical adjustments as described in cantilever weight adjustment and print head hexagonal rod adjustments. 4. Check for + 12 VDC at the output of E-38 on the digital board, see power supply schematic. If + 12 V is present, replace E-28, If problem persists, replace E-14 (digital board). If + 12 V is not present at output of E-34, check for +25V at input. If present, then E-34 is defective. (digital board)

No data points are being printed and display reads 000 uV for channel being monitored. Otherwise recorder appears to be functioning normally. It accepts commands and the print head is scanning.	1. Check the programming using the DISP key printouts. See the section titled, Programming Checks, in the Recorders/Dataloggers and RTU Instruments operating instructions manual for complete information on using the selections in the DISP key programming menu. 2. Check for proper grounding of inputs. 3. Check that input cable (J-101) is seated properly at both digital and input boards. 4. Display cold junction temperature. If reading appears normal (same as ambient temperature) the following chips may be defective: E-16 on the digital board E-113, E-114 or E-115 on the input board Q-11, Q-12, or Q-13 on the digital board If the C.J. temperature appears abnormal, check all DC voltages applied to the input board. Also, the following chips may be defective: E-10 or E-15 on the digital board E-105, E-108, E-110, E-111 or E-112 on the input board.
Digital printing is not parallel with horizontal chart paper grid lines.	1. Chart paper sprocket holes are improperly aligned on the drive roller.
Chart paper bunches behind print head when chart is advancing.	1. Check that teflon tape wrapped directly behind print head rest position on right side of print head hex rod is secure.
Excessive slack in chart paper.	1. Adjust clutch as shown in Chart Drive Maintenance section.

Chart paper advances erratically.	1. Q-l, Q-2, Q-3 or Q-4 on digital board is open. 2. D-9, D-10, D-11 or D-12 on the digital circuit board is shorted. 3. R-24, R-25, R-26, or R-27 on digital board is open. 4. Open solder connection to any of the above components may exist. 5. E-15 on the digital board may be defective. 6. Chart drive motor may be defective.
Chart paper does not advance.	1. Q-l, Q-2, Q-3 or Q-4 on digital board is open. 2. R-18 or R-56 on the digital circuit board is open. 3. E-15 on the digital circuit board is open. 4. Open solder connection to any of the above components may exist.
Chart paper take-up does not appear to operate properly.	1. Verify that leading edge of chart paper is taped securely to the take-up roll and that the notch in the cardboard take-up core is lined up with the key on the left side take-up disc/hub.

8.2 Digital Displays (Vacuum Fluorescent Display – VFD)

Left section VFD digits (1-16) not functioning.	1. E-7, E-15 one digital circuit board is defective. 2. E-401 on the display circuit board is defective. 3. Q-10 on the digital circuit board is defective. 4. DY -401 (VFD) on display circuit board is defective. 5. Display cable (J-4) may be bad.
Right section VFD digits (17-32) not functioning.	1. E-7, E-16 on the digital circuit board is defective. 2. E-402 on the display circuit board is defective. 3. Q-10 on the digital circuit board is defective. 4. DY -402 (VFD) on display board is defective. 5. Display cable (J-4) may be bad.
Left and right digits (1-32) flicker.	1. C-401 on the display board bad. 2. D-24 on the digital board bad (see power supply schematic).
Left and right digits (1-32) are extremely bright.	1. D-24 on the digital board bad (see power supply schematic).

Print head does not move, digital displays do not light and alarm buzzer beeps continuously when recorder is turned on.	1. Check that all IC chips are firmly seated in sockets, especially E-11, E-12, and E-13 on digital board. 2. Check all ribbon connectors and wiring harness plugs are properly seated in connectors. 3. Check all power supply voltages. 4. E-l, E-10 or E-35 on digital board may be defective. 5. X-1, the crystal on the digital board, may be defective. **NOTE:** The alarm buzzer may be deactivated during repair by disconnecting one end of R-48, from the digital board. Other circuits will not be affected.
One or more digits out on either VFD.	1. E-401 orE-402 on display circuit board defective 2. DY-401 or DY-402 (VFDs) on the display board defective. 3. Bad solder connections on the VFDs. 4. Bad solder connections to 10 K resistors on the display board.

8.3 Erroneous Data Readings

Make the following preliminary checks to determine if the problem is originating with the recorder or is being caused externally.

Instrument appears to be reading wrong values.

1. Check for proper grounding of the input signal connections. A diagram is screened on the rear panel and is also included in the operating instructions manual.

2. Check the type of input board (standard or high common mode) that your recorder is equipped with. If your recorder is equipped with the standard board ensure that the common mode voltage to the input does not exceed + 15VDC.

3. Clear the memory (X key procedure) and short together any channel positive, negative and ground connectors. Program the shorted channel as a voltage type and turn trend printing or datalog printing on. If the channel displays a reading from 00 to 10 u V the problem is with the input signal connections or the transducer.

4. Check the value of the inputs coming into the instrument with an accurate millivolt source.

Inaccurate data from one or more channels.

1. Possible defective multiplexer (MUX) chip on the input circuit board. There are four MUX chips with each one responsible for eight channels:,
E-101 channels 1-8
E-102 channels 9-16
E-103 channels 17-24
E-104 channels 25-32

E-108 is the main MUX chip and can affect the operation of the individual MUX chips listed above. Switch inputs to a different block of channels and check if inaccurate readings are still occurring. If readings are normal the indication is that the MUX chip for the original group of

	channels is defective. Troubleshooting can also be accomplished by switching chip E-108 with any of the other four, E-101-E-I04.
Scattered data points on all channels.	1. Possible defective main multiplexer chip (E-108). Swap main MUX chip with any of the other four: E-101 through E-104.
Random digital data.	1. E-15 or E-16 on digital board may be defective.
Inaccurate data from all channels.	1. Possible defective main multiplexer chip, E-108 on the input circuit board. 2. Check input board reference voltages at E-108. If reference voltages are correct, replace E-105 on the input board. 3. Possible defective cold junction pot. a. Short together the positive, negative and ground terminals for any channel. b. Program the channel as a temperature type by entering any of the *T/Cs* for type of channel. Enter ON for cold junction compensation. c. Turn the channel ON by entering ON for DATALOG PRINTING. d. Set up the recorder to print and display the reading on the VFDs. e. Program the operation mode (OPER key) to operate auto and check the CHART key for a datalog interval. f. Program the shorted channel for display in the H key menu. g. The cold junction temperature reading should be close to the ambient temperature. If not, try adjusting the cold junction pot. h. If the cold junction pot cannot be adjusted the temperature transducer (E-107) may be defective.

Data from channels is printed against the left or right margin.	1. Check programming in the PROG key, LEFT MARGIN IS and RIGHT MARGIN IS. 2. E-109, E-113, E-114, or E-115 on the input board may be defective.
No data being recorded from any channel.	1. Check input and output of DC/DC converter (V- 101), if O.K.: 2. E-108, E-109, E-110 or E-111 on the input board may be defective.
No data being recorded from l or more channels.	1. Check programming using the DISP key selections. Verify that channels have been turned on for trend or datalog printing, a chart speed is programmed and the chart drive motor is engaged in OPERATE/AUTO mode. 2. Move input to different block of 8 channels. (Four MUX chips are each responsible for 8 channels: E-101: channels 1-8 E-102: channels 9- 16 E-103: channels 17- 24 E-104: channels 25- 32. If data is recorded when inputs are moved the MUX chip in question is defective.
Left VFD displays OVRFL for certain channels and OVRFL is printed on the chart.	1. OVRFL (overflow) indicates a channel value has reached the overflow value of 99,999. If the channel in question has been programmed with an extra table as its type of channel, check the voltage to unit table by printing it out with the DISP key selection in TABLE. There is probably a mistake in the table. Delete the table and re-enter in the E key sequence. 2. If channel is programmed for the integration math function, clear the math programming and reprogram the channel.

8.4 Memory Loss

Memory loss of part or all of the programmed parameters results when instrument is turned off, then back on.	1. Check battery (B-l) voltage with instrument turned off. If voltage is less than 2 Volts, replace the battery. 2. With instrument turned off, monitor the voltage drop across R-32. It should be between 5 mV and 8 mV maximum. If higher, battery is being drained at shut down. E-5, E-6, E-17, E-23, E-24 or D-21 on the digital board may be defective (see power supply schematic).

8.5 Instrument Will Not Accept Commands

Instrument will not accept commands.	1. Check the L key programming. The instrument will not allow you to access most programming key menus when the keyboard is locked with a password. 2. Check Q-14, D-26, and associated components on the digital board. Q-14 must put out a 60 cycle square wave timing pulse to E-14. 3. E-14 on the digital board may be defective.
Instrument will not accept commands and there is no ASCII input/output.	1. E-33 or E-36 on the digital board may be defective, see power supply schematic.

8.6 Computer Input/Output

No RS-232 input and output.	1. Check programming procedure. Verify that ASCII OUT is ON in the PROG key menu sequence. Also verify that the baud rate and parity settings on the recorder are correct to match the peripheral device. 2. Verify pin connections on RS-232 I/O communications jack. See drawing #799071 in the operating instructions manual. 3. Check + and -12V power supply voltages. 4. E-31 or E-32 on the digital board may be defective. See 20mA current loop drawing 799078.
No RS-232 input.	1. Check programming procedure. Verify that ASCII OUT is ON in the PROG key menu sequence. Also verify that the baud rate and parity settings on the recorder are correct to match the peripheral device. 2. Verify pin connections on RS-232 I/O communications jack. See drawing #799071 in the operating instructions manual. 3. E-31 on the digital board may be defective. See 20mA current loop drawing 799078.
No RS-232 output.	1. Check programming procedure. Verify that ASCII OUT is ON in the PROG key menu sequence. Also verify that the baud rate and parity settings on the recorder are correct to match the peripheral device. 2. Verify pin connections on RS-232 I/O communications jack. See drawing #799071 in the operating instructions manual. 3. E-32 on the digital board may be defective. See 20rnA current loop drawing 799078.

No 20 mA current loop input.	1. Refer to drawing #799078 in operating instructions manual for proper wiring. 2. E-29 or E-31 on digital board may be defective.
No 20 mA current loop output.	1. Refer to drawing #799078 in operating instructions manual for proper wiring. 2. E-30 or E-32 on digital board may be defective. 3. Q-18 on the digital board may be defective.

8.7 Time Display And Clock

Clock is gaining or losing time when power is ON.	1. E-10 or E-14 on the digital board is defective
Clock does not keep accurate time when power is OFF.	1. Check the battery, B-l, on the digital board for at least 2 V 2. E-17 on the digital board is defective. 3. X-2 on the digital board is defective.

8.8 Intermittent Stops And Resets

Instrument intermittently stops, resets then continues to run.	1. Check that all IC chips are properly seated in sockets with no bent pints. 2. Check that all plugs are seated tightly in receptacles. 3. While instrument is operating, tap lightly on sections of the digital board with the insulated handle of a screwdriver or similar tool. a. If tapping causes instrument to stop operating this could indicate a cold solder connection on the digital board or a defective crystal, X-1. b. If light tapping on the digital board does not cause the instrument to stop operating this could indicate that E-l, E-10, orE-15 is defective. 4. Print head motor may be defective if intermittent stops are confined to the chart drive operation.
Instrument resets when attempting to program time and does not keep accurate time.	1. E-2, E-4, E-17 orE-35 on the digital board may be defective. 2. X-2, the clock oscillator, on the digital board may be unstable. Check C-28, C-29 and X-2 connections on the digital board.

8.9 Alarm/Control Relays

Selected relay does not function.	1. Check RELAY key programming and PROG key programming for those channels. 2. 2N2222 transistor or 1N4004 diode for selected relay may be defective, see relay board schematic, drawing #799107. 3. MCA 231 Opto-isolator for selected relay may be defective. 4. Relay cable (J-3) may be defective. 5. Relay cable may be open. 6. Verify relay contact operation with ohmmeter.

9. Parts

9.1 Hardware, Mechanical Parts, Belts and Drive Chains

General Description	Part #
Print head drive chain	307084
Chart drive belt	307090
Plastic cover for input terminals	701836
Latch for slide-out chassis	701922
Print head rod rubber insert	702041
Print head rod without rubber insert for sliding chassis models	780950
Print head rod without rubber insert for portable models	780067
Writing platen	780077
Replacement print head for sliding chassis models	801464
Replacement print head for portable and 20" models	801863
Print head drive chain pulley assembly	801746
Right side print head drive chain pulley for portable models	801879
Print head drive motor with plug-in connector	801766
Chart drive motor with plug-in connector	801767
Clutch assembly	801799
Print head slide assembly including print head for sliding chassis models	801797
Print head slide assembly including print head for portable models	801860

9.2 Electrical Parts, Assemblies And Cables

General Description	Part #
PROM update kit for instruments currently at 4-A and later software versions	805066
PROM update kit for instruments currently at 3-A and 3-B software versions	805065
PROM update kit for instruments currently at 2-U or earlier software versions	805064
SW1 Toggle switch used for on/off switch	112010
Removable, plug-in line cord	118009
10 conductor ribbon cable	122073
20 conductor ribbon cable	122153
0.25A chart light fuse	126018
Chart light replacement bulbs	801787
Fuse for power line 1A, Slo-blo	126021
Surge protector (110 V, 2 per instrument)	208001
Surge protector (220 V, 2 per instrument	208003
Line filter	208002
Complete keyboard assembly	801733
Print head cable with connectors	801775
Cold junction transducer and adjustment pot	101140

9.3 Electronic Components/Circuit Boards

9.3.1 Replacement circuit boards

General Description	Part #
Input circuit board (standard)	801737
Input circuit board for high common mode	802143
Controller input/output board for non printing units	802039
Controller input/output board for printing units	802094
Digital board with battery RAMs (standard)	802144
Digital board used in controller units	802042
Display board	801876
32 channel current source component board	802159
16 channel current source component board	802163
8 channel current source component board	802165
32 channel current source connector board	802160
16 channel current source connector board	802164
8 channel current source connector board	802166
Isolated relay board for sliding chassis, rack, free standing and NEMA models	801817
Isolated relay board for portable and table top models	801921

Suggested spare parts for customer stock

9.3.2 Digital circuit board components

Component #	Description/Value	Part #
B1	LITHIUM BAT POW CON 440S-PL	106004
C1,C42	CAP 30PFD 50V CERAMIC DISC	102158
C2	CAP .001 MFD 1KV SPRG 5GAD10	102023
C3	CAP .47MFD 35V	102173
C4,C17-C21,C30,C34-C41, C43,C46	CAP 1MFD 35V SPRG	102148
C5,C15	CAP 470MFD 35V AXIAL LD	102156
C6-C12	CAP 390PFD 10TST39	102168
C13	CAP 47MFD 35V TANT SPRG 1206-1	102152
C14	CAP 15000MFD 16V FHW15000M16	102169
C16	CAP 4700MFD 35V FHW4700M35	102170
C28,C29	CAP 20PF 5GA-Q20	102157
C31-C33	CAP .01 MFD 50V C.LAB CK103	102006
D1-D6	DIODE 1N5404	103072
D7-D16	DIODE IN4004	103028
D17-D21,D26-D33	DIODE IN4148	103042
D24	DIODE IN 4744 ZENER 15 V	103036
D25	DIODE 1N4737A	103080
D35	DIODE IN4735 ZENER 6.2V	103076
E1,E2	PR QUAD NAND FAIR. 7400PC	101128
E3,E35	OCT INV 74LS244	101208
E4	HEX INVERTER 74LSO4	101190
E5	CMOS QUAD NAND 4093	101127
E6	HEX INVERTER 74HC14	101211
E7	HEX INVERTER 74HCO2	101207
E8	74LS139	101193
E9	3-8 DECODER 74LS138	101194
E10	MOS6502 MICROPROCESSOR	101125
E11,E12,E13	IC 27128 PROMS	101213
E14-E16	INTERFACE 6522	101126
E17	REAL TIME CLOCK MM58167	101195
E18	AICIA MOS 6551	101196
E19	LINEAR REG MC7915 CT	101121
E20	REG NAT. LM309K	101130
E21,E22	SRAM HM6116-4	101197
E23,E24	DALLAS DS1220-Y	101239
E25-E28	DRVR NATL. DS 75452N	101219
E29,E30,E37	T.I. 4N37 OPTO ISO	101220
E31	RS 232 REC DS1489	101199
E32	RS232 DRDR DS1488	101200
E33,E38	REG LM7812CT	101210
E34	MC7815CT	101176
E39	REG LM7912CT	101209
F2	FUSE 1/4A PICO FUSE M255-250	126018
Q1-Q8	TRANSISTOR MOT-2N6039	101143
Q9,Q11-Q13	TRANSISTOR 2N2222	101146
Q10	TRANSISTOR MPSA55	101161
Q15	2N3904	101188
Q18	TRANSISTOR 2N2907	101158
R-0 Mounts to E28	RES 470 OHM 1/4W 5%	100264
R-00 (mounts on back)	RES 1/8W 5% 4.7K	100725
R1	RES 3.3K 1/4W 5%	100606
R2,R3,R37-R40	RES 2K 1/4W 5%	100279
R4,R5,R6,R36	RES 1K 1/4W 5% CARB	100568
R7-R14	RES 4.7K 1/4W 5%	100288
R15,R16	RES 220 OHM 1/4W 5%	100619
R17	RES 220K 1/2W 5%	100114
R18,R19,R56,R57	RES 33 OHM 10W 10%	100589
R20,R21	RES 1 MEG 1/4W 5%	100344
R22	RES 100K 1/4W 5%	100320

R23	RES 470 OHM 1/8W 5% CARB FLM	100719
R24-31,R46,R48,R49,R58	RES 100 OHM 1/4W 5%	100248
R32	RES 1K 1/8-1/4W 1%	100486
R33,R42-R45	RES 820 OHM 1/4W 5%	100670
R41,R62	RES 20K 1/4W 5% CARB	100601
R47	RES 560 OHM 1/2W 5%	100083
R50,R59,R61	RES 10K 1/4W 5% CARB	100569
R51,R52	RES 470 OHM 1/2W 5%	100082
R53	RES 27K 1/4W 5%	100612
R54,R60	RES 62K 1/4W 5%	100674
X1	1MHZ MICROPROCESSER XTAL	101145
X2	XSTAL 3KHZ SEIKO OS-VT-300	101201
X3	XSTAL MP-2-1.8432 MTRON HC-33U	101202
Z1	BUZZER MORATA/ERIE PKB8-4A0	109002
Digital board hardware:		
E1-E7,E31,E32	14 PIN IC SOC 802-0141642	128115
E8,E9	16 PIN IC SOC 802-0161642	128116
E10,E14,E15,E16	40PIN SOC 802-7401642	128119
E11-E13,E33	28 PIN SOC 802-7287642	128120
E17,E21-E24	IC SO 24 PIN 802-7241642	128169
E19,E38	HT SINK THERM. 6073PB	105017
E20	HT SINK THERM. 6354B-2	105018
E20	INSUL THERM. 7717-152	105019
E25-E28	8 PIN IC SOC 802-0081642	128114
E29,E30,E37	6 PIN IC SOCKET	128148
F2	FUSE HOLDER 281005 LF	126023
J1,J3	HEADER MALE 20P 609-2027	128129
J2,J7	HEADER 6P PAND HLAS156-6	128173
J4,J8	HEADER MALE 10P 609-1027	128123
J5,J6	HEADER 26P 609-2627	128147
J9	HEADER 10P PAND HLAS156-10	128172
J10,J12	HEADER 2P PAND HLAS156-2	128171

9.3.3 Isolated relay circuit board components

Component #	*Description/Value*	*Part #*
C301-C312	CAP .001 MFD 1KV SPRG 5GAD10	102023
C313-C324	CAP .01MFD 1KV 20%	102019
C325	CAP 4700MFD 35V FHW4700M35	102170
D301-D312	DIODE IN4148	103042
D313-D317	DIODE 1N5404	103072
E301-E312	T.I. 4N37 OPTO ISO.	101220
Q301-Q312	TRANSISTOR 2N2222	101146
R301-R312	RES 2.7K 1/4W 5%	100282
R313-324	RES 10K 1/4W 5% CARB	100569
Relay board hardware:		
J301-J304	12 PIN HDR 1103.6 WEIDMULLER	120174
J301-J304	WEIDMULLER 12601.6	120175
J303	HEADER MALE 20P 609-2027	128129
E301-E312	6 PIN IC SOCKET	128148
J302	2 PIN HEADER PANDUIT HFSS156-2	128199
S301-S312	MIN-JMP CONN. BERG65474-001	128204
S301-S312	BERG 3 PIN HDR 65507-103	128205
RY301-RY312	RELAY SPDT T70L5D131-24 P&B	134033

9.3.4 Input circuit board components

Component #	*Description/Value*	*Part #*
C101-C139	22uf 35v LO LEAKAGE RAD CAP	102147
C140	CAP .1MFD 100V 10%	102012
C141	CAP .001 MFD 1KV SPRG 5GAD10	102023
C150-C158	CAP 1MFD 35V SPRG	102148
D101	DIODE IN4148	103042
E101-E105,E108	MUX HARRIS HI1507A-5	101136
E106	10V REF LH0070-2H NATL	101141
E107	TEMP TRANSDUCER LM 335Z	101140
E109	OPAMP OP-O7CP	101183
E110,E111	OP-AMP NATL LF353N-LMOK	101137
E112-E115	T.I. 4N37 OPTO ISO	101220
N101	RES CADDOCK 1787-412	100588
Q101	TRANSISTOR FET MOT 2N4220	101144
R101-R178	RES 10K 1/2W 5%	100098
R179	RES CADDOCK 9K TFO20R	100590
R180	RES 3K 1/4W 1%	100489
R181	RES 1K 1/4W 1%	100518
R182	RES 7.5K 1/4W 5%	100293
R183	20K MULTI TURN 114068 W/BRKT	114074
R184-R186	RES 150 OHM 1/4W 5%	100252
R187	RES 20K 1/4W 5% CARB	100601
R188	RES 2K 1/4W 5%	100279
R189-R191,R196,R202	RES 10K 1/4W 5% CARB	100569
R192	RES 82K 1/4W 5% CARB	100602
R193	RES 2.7K 1/4W 5%	100282
R194,R206,R209	RES 4.7K 1/4W 5%	100288
R195	RES 6.8K 1/4W 5% CARB	100599
R197,R203,R204	RES 1 MEG 1/4W 5%	100344
R198	RES 1.5 MEG 1/4W 5% CARB	100603
R199,R205	RES 100 OHM 1/4W 5%	100248
R200	RES 910 OHM 1/4W 5% CARB	100593
R201,R207	RES 9.1K 1/4W 5% CARB	100594
R208	RES 1K 1/4W 5% CARB	100568
V101	DC/DC CONVERTER (101142)	811573
Input circuit board hardware:		
Q101	TRANSISTOR PAD 7717-86N	105015
E106	INSUL THERM. 7717-152	105019
	16 CON TERM STRIP BEU 72316-53	120155
	SOLDER LUG #6 FEDERAL 1955	120170
	8 PIN IC SOC 802-0081642	128114
	28 PIN SOC 802-7287642	128120
	HEADER MALE 20P 609-2027	128129
	6 PIN IC SOCKET	128148

9.3.5 Display circuit board components

Component #	*Description/Value*	*Part #*
	RES 10K 1/8W 5% CARB	100671
	CONT ROCKWELL 10937-40	101203
	CAP 10MFD 25V	102130
	16 CHAR DISP 16MY-01ZL FUTABA	108048
	40PIN SOC 802-7401642	128119
	HEADER MALE 10P 609-1027	128123
	FAST TAB AMP 61134-1	128189
	3/32X1/4 CLOSED CELL SPONG GAS	613011

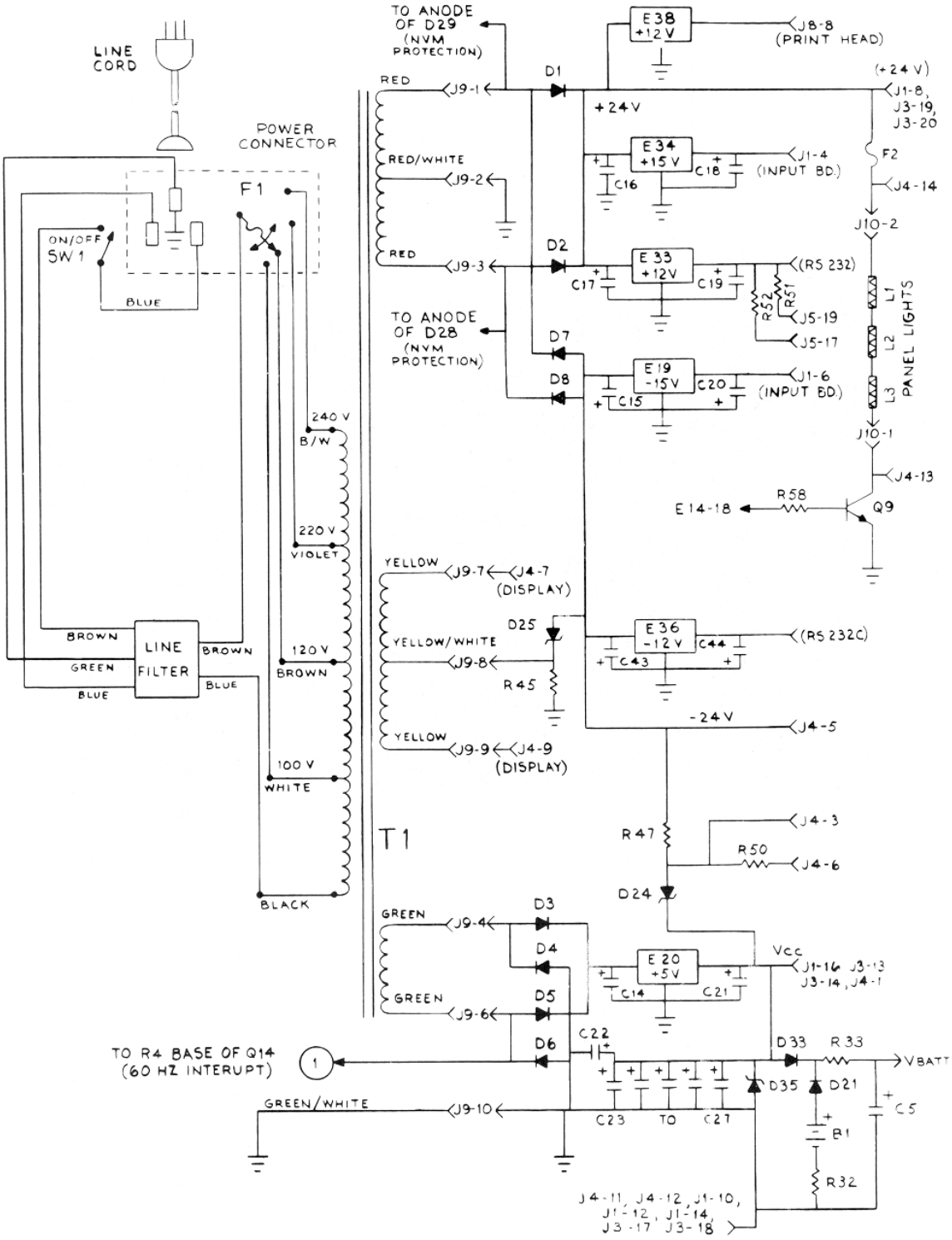
9.3.6 Controller input\output circuit board components

Component #	*Description/Value*	*Part #*
C601,C604,C607,C610	CAP 47MFD 35V TANT SPRG 1206-1	102152
C602,C605,C608,C611,C628	CAP .01 MFD 50V C.LAB CK103	102006
C603,C606,C609,C612	CAP 30PFD 50V CERAMIC DISC	102158
C613-C616,C618-C623,C-625, C627,C647-C654	CAP 1MFD 35V SPRG	102148
C617,C628	CAP .001 MFD 1KV SPRG 5GAD10	102023
C624	CAP .1MFD 100V 10%	102012
C629-C643	22uf 35v LO LEAKAGE RAD CAP	102147
C644,C645,C646	CAP 4700MFD 35V FHW4700M35	102170
D601-D621	DIODE IN4148	103042
D622-D629	DIODE 1N5404	103072
E601,E602,E606,E607,E611, E612,E616,E617,E621,E622	74HCT373 NAT SEMI COND/ RCA	101235
E603,E608,E613,E618	HARRIS HI-1-565AJD-5	101233
E605,E610,E615,E620	LM324N	101162
E623,E624,E625,E626	T.I. 4N37 OPTO ISO	101220
E627	IC WC 3524 AN	101212
E628,E633,E634	MUX HARRIS HI1507A-5	101136
E629,E630	OP-AMP NATL LF353N-LMOK	101137
E632	10V REF LH0070-2H NATL	101141
Q601,Q603,Q605,Q607	TRANSISTOR 2N2222	101146
Q602,Q604,Q606,Q608	TRANSISTOR 2N2907	101158
Q609	IC MC79L15ACP 15V REGULATOR	101155
Q610	IC 78L15AWC 15V REGULATOR	101156
Q611	TRANSISTOR FET MOT 2N4220	101144
Q612	TEMP TRANSDUCER LM 335Z	101140
R601,R619,R637,R655	RES 50 OHM .1% CMF-55	100634
R602,R620,R638,R656	BECKMAN 66WR100	114085
R603,R621,R639,R657	RES 1.1K 1/4W .1% T2	100718
R604,R622,R640,R658	RES 1.43K 1/4W .1% T2	100717
R605,R611,R623,R624,R641, R647,R659,R665	BECKMAN 66WR1K	114086
R606,R624,R642,R660	RES 1.8K 1/4W .1% T2	100714
R607,R614,R625,R632,R643-R650,R661,R668,R673,R676, R677-R682,R691,R696	RES 10K 1/4W 5% CARB	100569
R608,R626,R644,R662	RES 2K 1/4W .1% T2	100715
R609,R627,R645,R663	RES RN55D 200 OHM 1%	100660
R610,R613,R628,R631,R646, R649,R664,R667	RES 5K 1/4W 1%	100587
R612,R630,R648,R666,R704	RES 1K 1/4W 5% CARB	100568
R615,R633,R651,R669	RES 3.3K 1/4W .1% T2	100716
R616,R634,R652,R670	RES 100 OHM 1/2W 1% T2	100713
R617,R635,R653,R671	RES 3.9K 1/4W .1% T2 CMF60	100711
R618,R636,R654,R672	RES 390 1/4W .1% T2 CMF60	100712
R674	RES 20K 1/4W 5% CARB	100601
R675,R678,R679	RES 150 OHM 1/4W 5%	100252
R680	RES 9.1 OHM 1/4W 5% CARBON	100592
R681	RES 5.6K 1/4W 5%	100290
R683	RES 910 OHM 1/4W 5% CARB	100593
R684,R687	RES 9.1K 1/4W 5% CARB	100594
R685	RES 1K 1/4W 1%	100518
R686,R699	RES 100 OHM 1/4W 5%	100248
R688	RES 1.5 MEG 1/4W 5% CARB	100603
R689	RES 6.8K 1/4W 5% CARB	100599
R690,R700,R705	RES 4.7K 1/4W 5%	100288
R692	RES 82K 1/4W 5% CARB	100602
R693,R697,R698	RES 1 MEG 1/4W 5%	100344
R694	RES 2.7K 1/4W 5%	100282
R695	RES 2K 1/4W 5%	100279

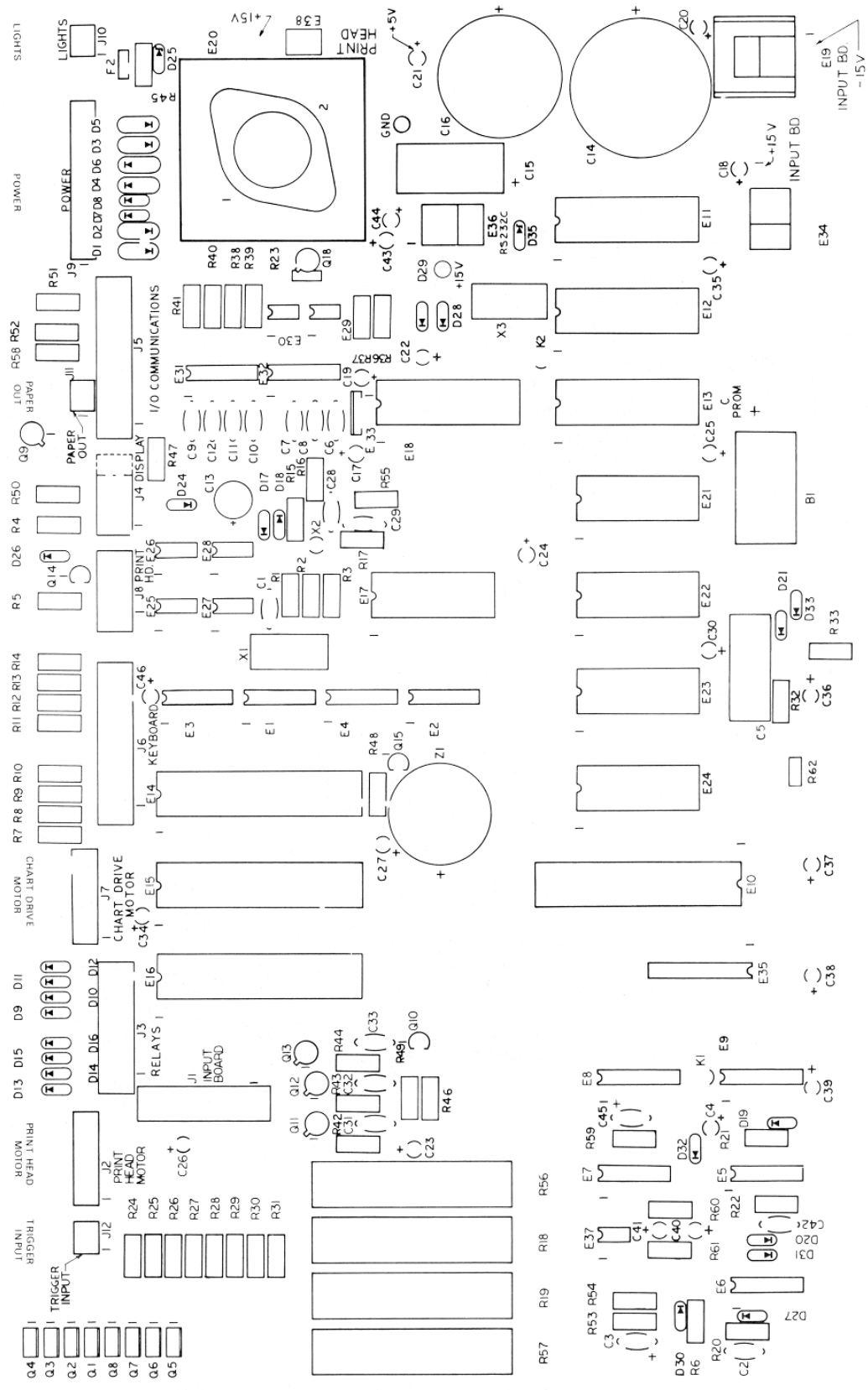
R701	RES CADDOCK 1787-412	100588
R702	RES CADDOCK 9K TFO20R	100590
R703	RES 3K 1/4W 1%	100489
R706-R718; R720-R736	RES 10K 1/2W 5%	100098
R719	RES 7.5K 1/4W 5%	100293
T601	TOROIDAL TRANSFORMER	104076
T602	TOROIDAL TRANSFORMER	104075
VR601	REG NAT. LM309K	101130
VR602	LINEAR REG MC7915 CT	101121
VR603	MC7815CT	101176
Controller input/output board hardware:		
	20K MULTI TURN 114068 W/BRKT	114074
E601,E602,E606,E607,E611,E612, E616,E617,E621,E622	SOC 20P IC 802-020-1642	128193
E603,E608,E613,E618	IC SO 24 PIN 802-7241642	128169
E605,E610,E615,E620	14 PIN IC SOC 802-0141642	128115
E623,E624,E625,E626	6 PIN IC SOCKET	128148
E627	16 PIN IC SOC 802-0161642	128116
E628,E633,E634	28 PIN SOC 802-7287642	128120
E629,E630,E631	8 PIN IC SOC 802-0081642	128114
E632	TRANSISTOR PAD 7717-86N	105015
J601,J602,J603	HEADER MALE 20P 609-2027	128129
J604	HEADER 10P PAND HLSS156-10	128206
Q601-Q608,Q611	INSUL THERM. 7717-152	105019
VR601	MICA THERMALLOY 56-03-10	105012
VR601	HEAT SINK 423-TO-3	105014
VR602,VR603	HT SINK THERM. 6073PB	105017

9.3.7 Current source circuit board components

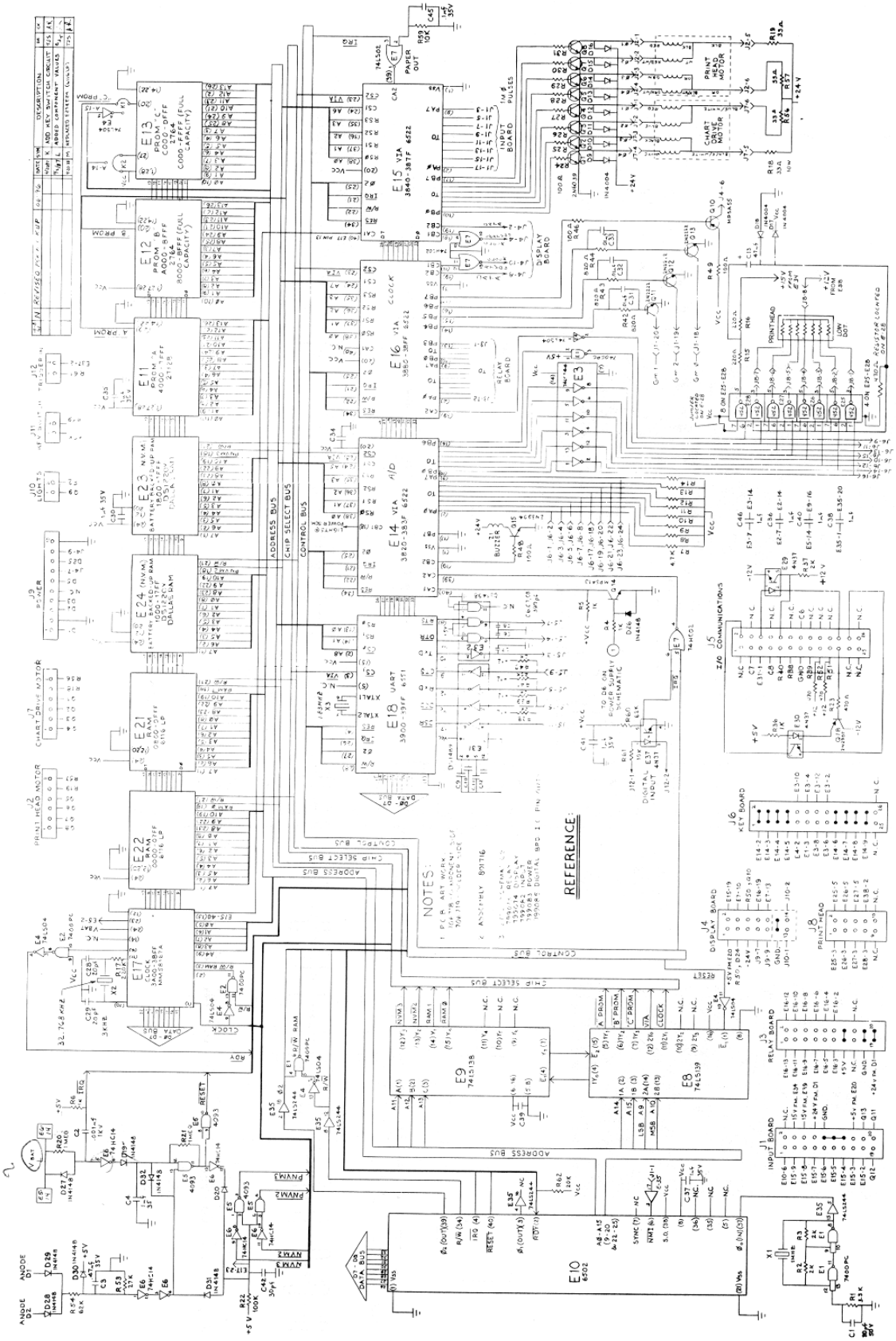
Component #	*Description/Value*	*Part #*
	RES 10K 1/4W 5% CARB	100569
	RES 5K 3W 5%	100650
	RESISTOR CMF55 T2 .25% 20K	100651
	RESISTOR CMF55 T2 .25% 40.7K	100652
	RESISTOR CMF55 T2 .25% 3.32K	100653
	LINEAR REG MC7915 CT	101121
	10V REF LH0070-2H NATL	101141
	MC7815CT	101176
	LF 444CN NATIONAL	101184
	FET PN4393 SILICONIX	101186
	CAP 1MFD 35V SPRG	102148
	CAP 470MFD 35V AXIAL LD	102156
	DIODE IN4004	103028
	DIODE IN4148	103042
Current source and connector board hardware:		
	MICA THERMALLOY 56-03-10	105012
	TRANSISTOR PAD 7717-86N	105015
	HT SINK THERM. 6073PB	105017
	1K TRIMMER POT	114072
	14 PIN IC SOC 802-0141642	128115
	HEADER MALE 34P 609-3427	128155
	HEADER 4 P PAND. HLAS156-4	128234
	HEADER 3 P PAND. HLAS156-3	128235
	8 PIN HDR WEIDMULLER 13497.6	120198
	8 PIN SOC 12823.6 WEIDMULLER	120199
	HEADER MALE 34P 609-3427	128155



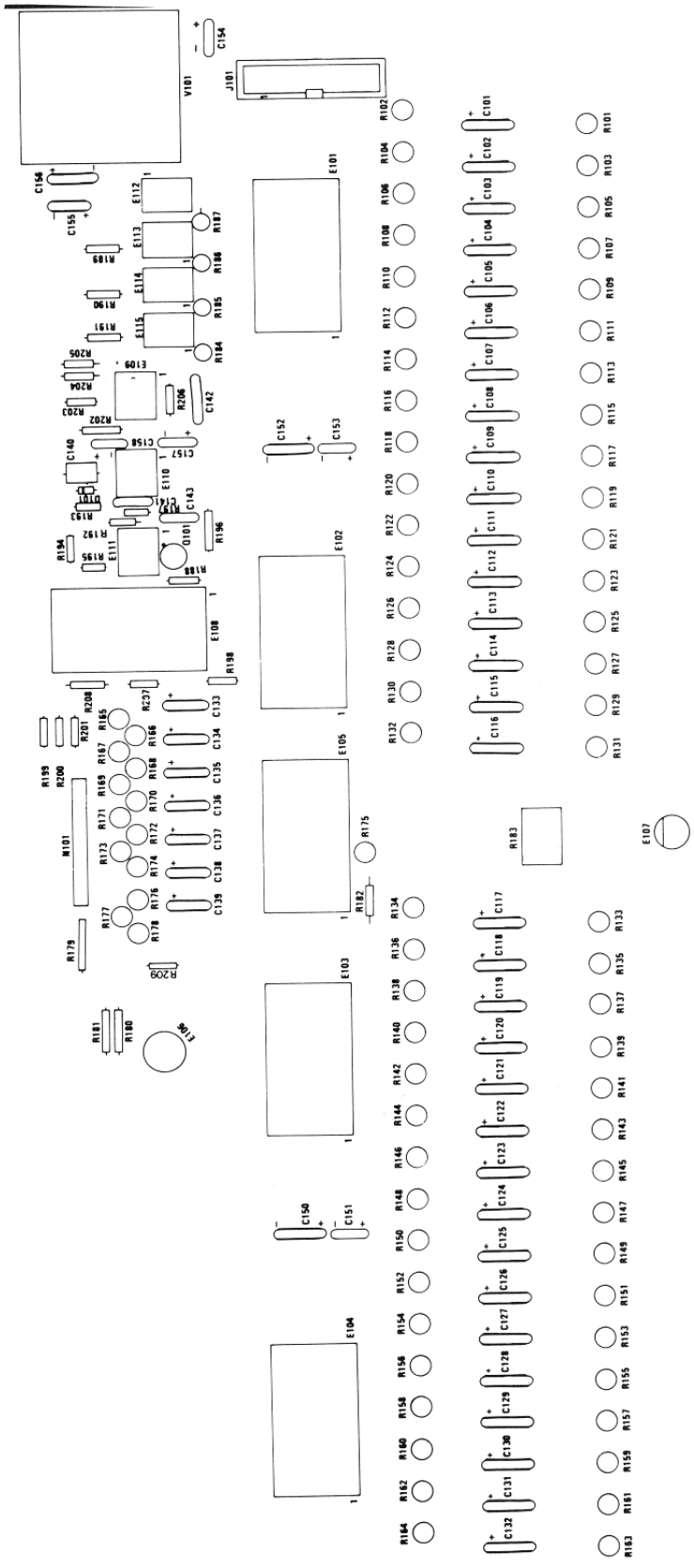
POWER SUPPLY SCHEMATIC, DRAWING #799083



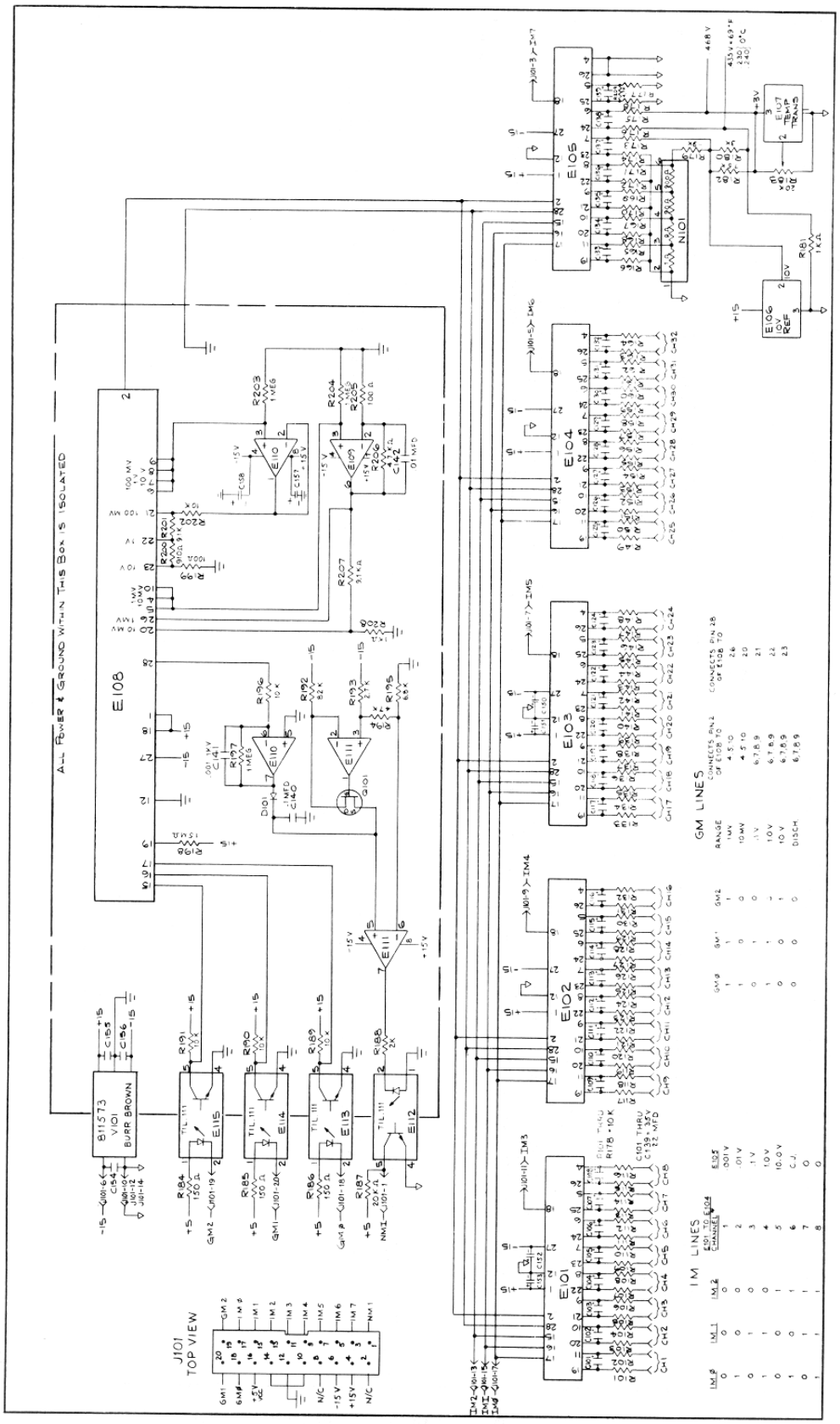
DIGITAL BOARD COMPONENT MAP, DRAWING #726718



DIGITAL BOARD SCHEMATIC, DRAWING #799065



INPUT BOARD COMPONENT MAP, DRAWING #726514


ALL POWER & GROUND WITHIN THIS BOX IS ISOLATED
E108
B11573
V101
BURR BROWN
J101
TOP VIEW
IM LINES
GM LINES
E101
E102
E103
E104
E105
E106
E107
Q101
D101
R201
R202
R203
R204
R205
R206
R207
R208
R209
R210
R211
R212
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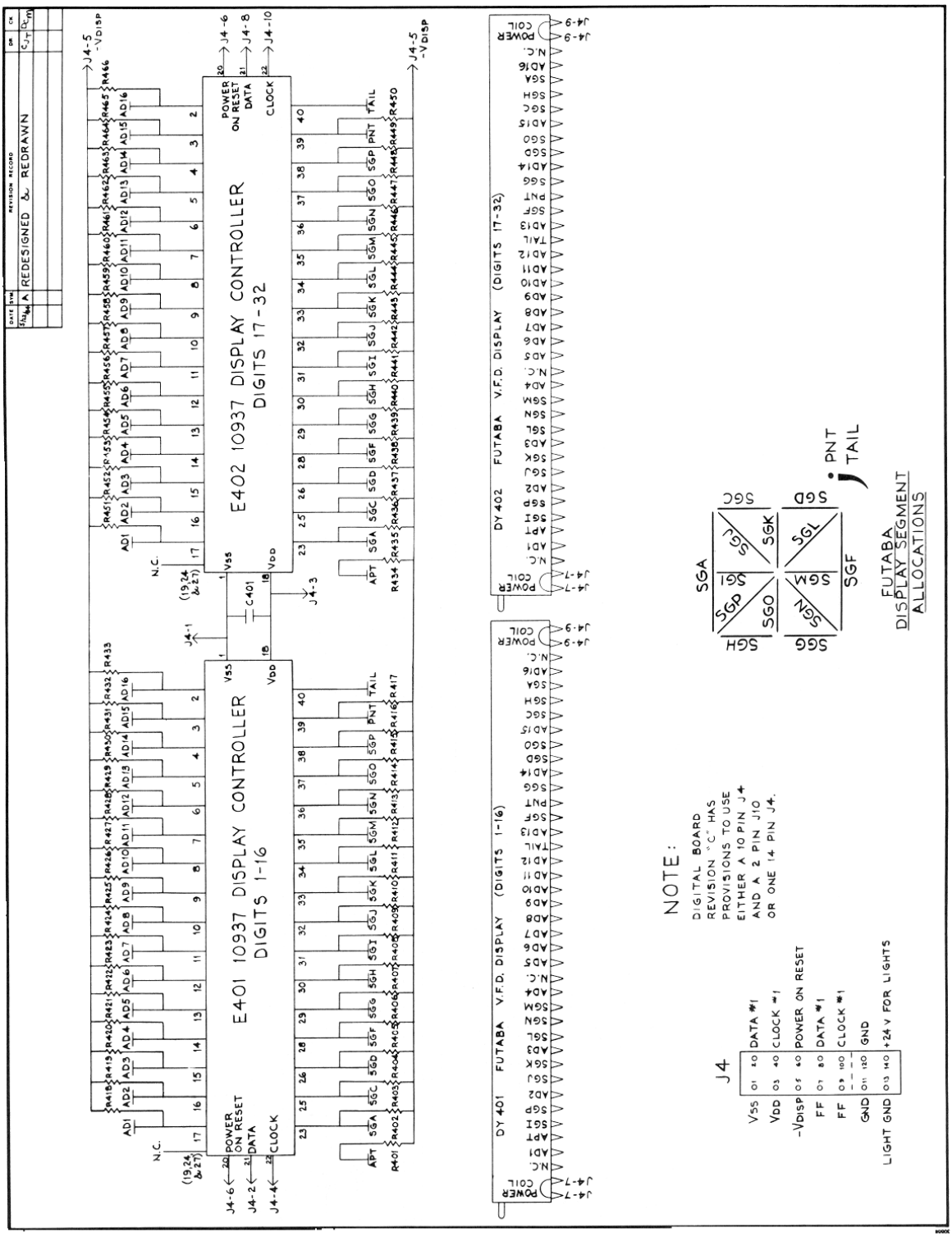
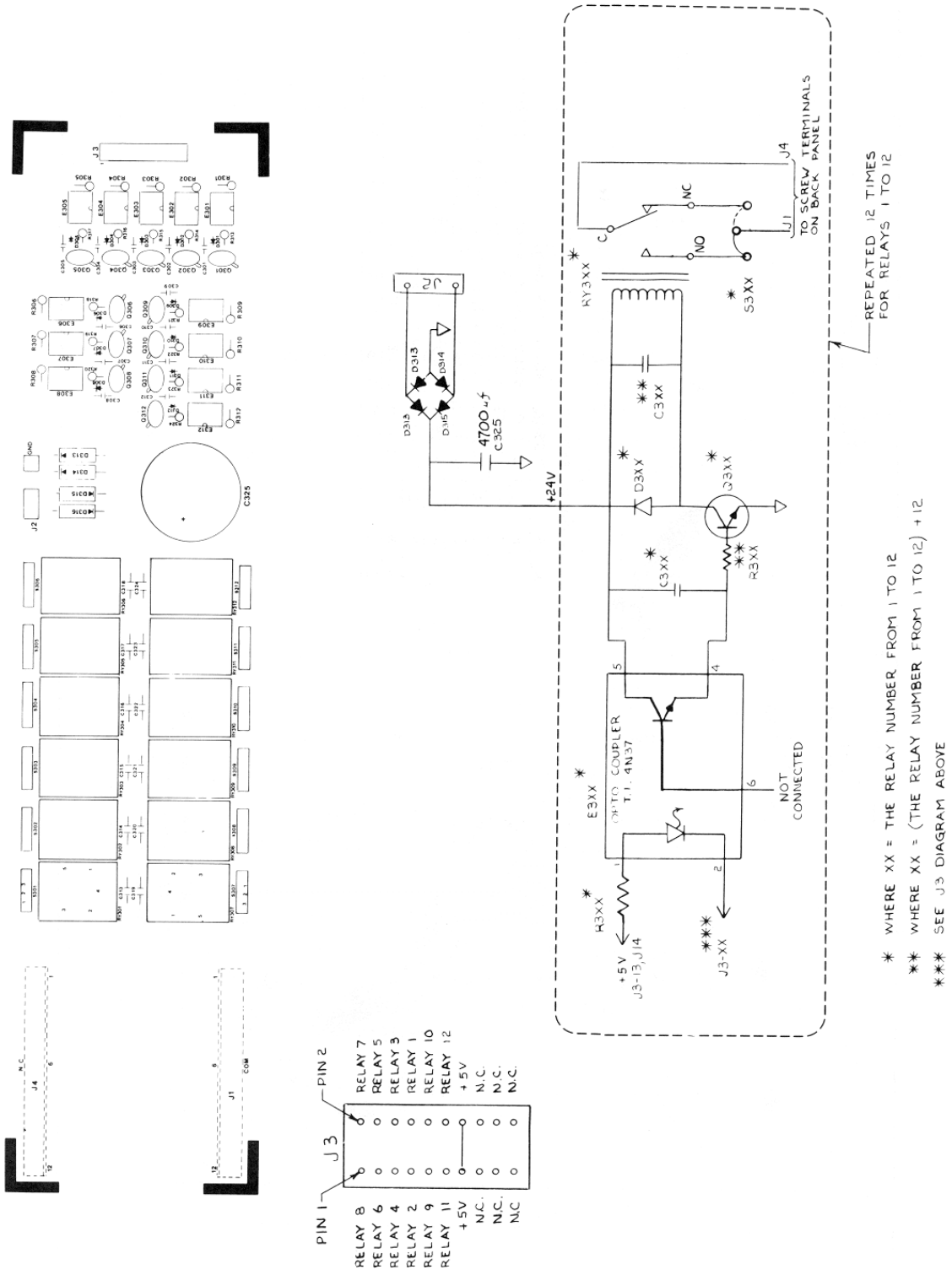
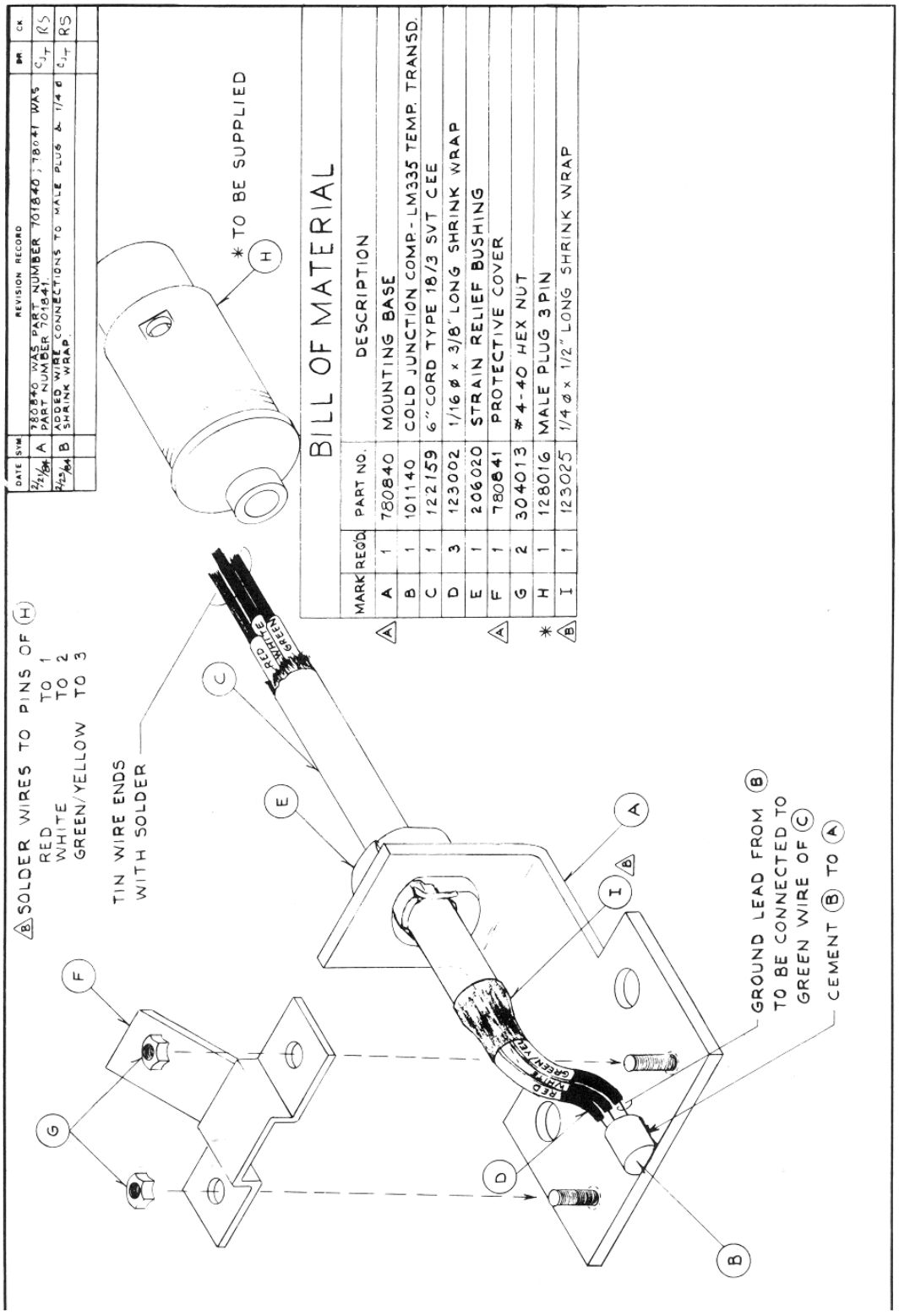


DISPLAY BOARD SCHEMATIC, DRAWING #799074



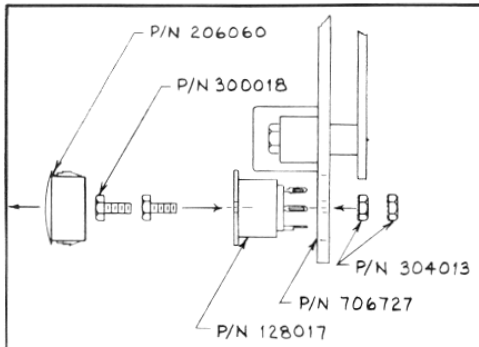
RELAY BOARD SCHEMATIC, DRAWING # 799107


REVISION RECORD
DATE
SYM
DR
CK
2/21/84 A 780840 WAS PART NUMBER 701840 ; 780841 WAS PART NUMBER 701841 CJT RS
2/25/84 B ADDED WIRE CONNECTIONS TO MALE PLUG & 1/4 ø SHRINK WRAP CJT RS
BILL OF MATERIAL
MARK REQD PART NO. DESCRIPTION
A 1 780840 MOUNTING BASE
B 1 101140 COLD JUNCTION COMP.-LM335 TEMP. TRANSD.
C 1 122159 6" CORD TYPE 18/3 SVT CEE
D 3 123002 1/16 ø x 3/8" LONG SHRINK WRAP
E 1 206020 STRAIN RELIEF BUSHING
F 1 780841 PROTECTIVE COVER
G 2 304013 #4-40 HEX NUT
H 1 128016 MALE PLUG 3 PIN
I 1 123025 1/4 ø x 1/2" LONG SHRINK WRAP
* TO BE SUPPLIED
SOLDER WIRES TO PINS OF (H)
RED TO 1
WHITE TO 2
GREEN/YELLOW TO 3
TIN WIRE ENDS WITH SOLDER
GROUND LEAD FROM (B) TO BE CONNECTED TO GREEN WIRE OF (C)
CEMENT (B) TO (A)
RED
WHITE
GREEN

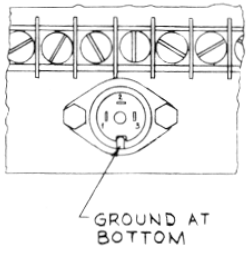
REMOTE COLD JUNCTION ASSEMBLY, DRAWING #801711

PANEL CONNECTIONS FOR REMOTE COLD JUNCTION ASSEMBLY, DRAWING #801773

DATE	SYM.	REVISION RECORD	DR.	CK.



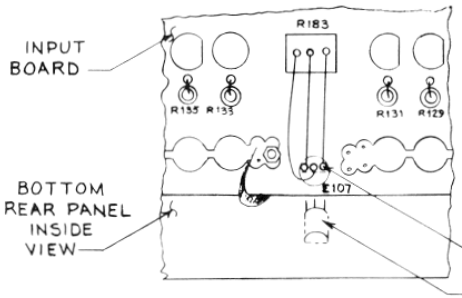
SIDE VIEW



FRONT VIEW

STEP ONE

REMOVE 5/8"ø HOLE PLUG (P/N 206060) IN LOWER REAR PANEL (P/N 706727) AND REPLACE WITH FEMALE 3 PIN PLUG (P/N 128017). FASTEN IN PLACE WITH TWO #4-40 x 1/4" HEX HEAD SCREWS (P/N 300018) AND TWO #4-40 HEX KEP NUTS (P/N 304013).



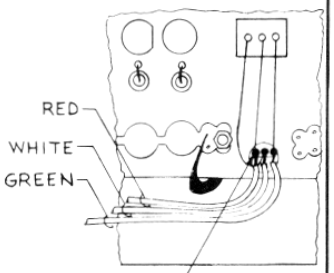
VIEW AT E107

STEP TWO

CUT THE 3 LEADS OF THE TRANSDUCER ATTACHED TO E107 ON BOARD. PRY OFF TRANSDUCER WHERE GLUED TO REAR PANEL. CLEAN OUT TRACE HOLES ON E107 WITH SOLDER WICK.

STEP THREE

CUT 6" EACH OF 22 AWG WIRE: RED (P/N 122019), WHITE (P/N 122026), AND GREEN (P/N 122022). STRIP OFF ONE END OF EACH, TWIST WIRE STRANDS TOGETHER, AND TRIM BACK TO 1/8". TIN THESE LEADS AND SOLDER TO THE HOLES OF E107, HAVING RED ON LEFT, WHITE IN CENTER, AND GREEN ON RIGHT.



STEP FOUR

RUN JUMPERS CLOSE TOGETHER TO PINS ON FEMALE PLUG. STRIP, TWIST, TRIM, & TIN LEADS BEFORE SOLDERING RED WIRE TO PIN 1, WHITE TO PIN 2, & GREEN TO PIN 3. BUNDLE TOGETHER WITH CABLE TYES (P/N 124001) IN TWO PLACES.